

**BIBLIOGRAPHY OF NONDESTRUCTIVE TESTING
THEORY AND APPLICATION
FOR
COMPOSITES**

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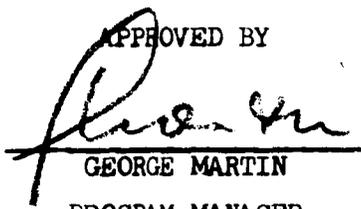


BIBLIOGRAPHY OF NONDESTRUCTIVE TESTING
THEORY AND APPLICATION
FOR
COMPOSITES

NORTH AMERICAN AVIATION, INC., LOS ANGELES DIVISION
LOS ANGELES, CALIFORNIA
FOR
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

A Partially Annotated Bibliography

APPROVED BY



GEORGE MARTIN
PROGRAM MANAGER

DATE 15 October 1965
NO. OF PAGES 222



NORTH AMERICAN AVIATION, INC. / LOS ANGELES DIVISION
INTERNATIONAL AIRPORT • LOS ANGELES, CALIFORNIA 90009

FOREWARD

This bibliography was prepared by North American Aviation, Inc., Los Angeles Division, under two research contracts. Contract NAS8-11733, Development of Nondestructive Testing Techniques for Honeycomb Heat Shields, for the George C. Marshall Space Flight Center, NASA, is administered under the direction of the Contracting Officer, Mr. W. M. McKinney, and the Contracting Officer Representative, Mr. Wayman Clotfelter, Propulsion and Vehicle Engineering Laboratory, Materials Division, George C. Marshall Space Flight Center. Air Force Contract No. AF33(615)-2865, "Research and Development of Nondestructive Testing Techniques Development for Composites" covers work done on metallic fiber-matrix composites for the Air Force Materials Laboratory, W-PAFB.

The development program is supervised by Mr. J. F. Moore, Program Engineer, under the direction of Mr. N. Klimmek, Chief, Materials and Producibility, and Dr. George Martin, Program Manager. The literature compiled for this bibliography was reviewed and cataloged by Dr. George Martin and Mr. J. F. Moore.

ABSTRACT

A comprehensive literature survey was conducted as one phase of work performed under the NASA and Air Force contracts identified in the Foreward. Literature relating to nondestructive testing theory, techniques and equipment was collected and indexed. Material relating to ultrasonics and ultrasonic testing equipment and techniques was of primary interest, however other fields of nondestructive testing are also included in the survey. Related subject material concerning honeycomb and sandwich construction, composites, and bonding, are included to provide helpful background information.

DESCRIPTIVE TERMS

Acoustic Techniques	Literature Survey
Development	Metallic-matrix Composites
Decrement	Nondestructive Test(ing) (NDT)
Disbonds	Pulse-echo
Eddy-sonic	Quality Control (QC)
Fiber-matrix Composites	Recording
Fiber-to-matrix Disbonds	Resonance
Filament-wound Composites	Sandwich Structure
Honeycomb Composite	Scanning
Impedance	Through-transmission
Intermodulation	Ultrasonic(s) (U/S)

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INTRODUCTION

This bibliography is comprised of reports and articles researched in seeking information relevant to developing nondestructive testing techniques for honeycomb and metallic fiber-matrix composites and materials. Included are subjects covering various testing techniques, theories, and equipment, and general background information.

The list is intended as a general compilation rather than one providing all-inclusive coverage. One report alone quotes over 7000 references on ultrasonics up to 1954. Therefore, in compiling this list, an attempt was made to confine the effort to relatively current information. Some earlier reports and articles providing valuable background information are also included.

Literature listed herein represents only that which has been collected, reviewed, cataloged (by author and category), and installed in the laboratory file. The document listing is arranged by major categories which appeared best suited to the current investigation. Each category is further subdivided for convenience in retrieval of information. Documents within each subdivision are arranged alphabetically by author. The apparent overlap between some subdivisions and literature cataloging is recognized. However, again the final decision was based on present and future program effort.

When available, abstracts were included with the listing. In some cases, a skeletal abstract or description of the subject material was prepared. Listings which do not include either abstract or description, although pertinent, were considered too brief or general in nature to warrant abstracting.

Literature presented in this bibliography does not include any classified information, but it does include literature generated by DOD and NASA that, at time of survey, was not cleared for publication.

1. NONDESTRUCTIVE TESTING - GENERAL PAPERS

11. NDT SURVEYS - GENERAL

A REVIEW OF THE AIR FORCE MATERIALS RESEARCH AND DEVELOPMENT PROGRAM

J.J. Banks, D.J. Tate

WADC-TR-53-373

March 1962

W-P AFB

These reports cover basic and applied research in the materials area being conducted by the Metals and Ceramics, Nonmetallic Materials, Physics, Manufacturing Technology and Applications Laboratories of the Directorate of Materials and Processes.

ADVANCES IN NONDESTRUCTIVE METAL TESTING

B. Banks

Metal Industry
pp 390-393 Vol 130 No. 12

September 19, 1964

A short survey of nondestructive testing techniques was presented. Included in the discussion was radiography, particle acceleration, Xerography, X-rays, and ultrasonics. A, B, and C scan units, multi-probe systems and the use of square wave pulses with extremely short rise and decay times were among the ultrasonic methods discussed.

Of obvious interest.

Spectrum Anal.

NONDESTRUCTIVE TESTING

D.D. Dodge

Mechanical Engineering
pp 38-43

August 1962

A general review of the various methods of nondestructive testing was given. Radiography, eddy current techniques and ultrasonics were the main topics covered. The article provides an elementary introduction to basic techniques. (Good table on NDT testing methods)

Cat: 11

1.

NEW APPROACH TO NDT DEMANDED BY THE DEEP-DIVING SUBMERSIBLE
PROGRAM

S. Goldspiel

ASME Pub 65-UNIT-9

The paper proposes a new set of requirements for non-destructive tests when quantitative data are required to provide a better balance between quality and costs. These requirements are discussed in the light of improvements and new approaches needed to advance NDT methods from the current qualitative status to a sorely needed quantitative level. Of all requirements, two are of uppermost importance. These are: (1) Making NDT indications meaningful in terms of fabrication deficiencies, and (2) relating the severity of NDT indications to engineering performance.

PHYSICS IN NONDESTRUCTIVE TESTING

W.J. McGonnagle

Metal Progress
pp 132-136

May 1964

A highly qualitative report was given on the 1963 Symposium on physics and Nondestructive testing. Covered in the report were physics of failure, ultrasonics, the Mossbauer effect, radiation and properties of materials. The ultrasonic section was primarily concerned with methods of determining the magnitude of internal stresses.

NONDESTRUCTIVE TESTING

W. McGonnagle

International Science and Technology*

July 1964

*Reprinted in Materials Evaluation
pp 561-571

December 1964

NEW DEVELOPMENTS IN NDT OF SMALL COMPONENTS AND THIN-GAGE
MATERIALS

R.C. McMaster

Ohio State University (paper)
Columbus, Ohio

1965

WHY NONDESTRUCTIVE TESTING IS NEEDED

R.C. McMaster

Metal Progress
pp 70-79

January 1961

The constant increase in competition coupled with the growing demand for quality has caused manufacturing industries to concentrate on nondestructive testing as a means for reducing waste and improving reliability. A number of the general aspects, including both production and economic standpoints, to be considered in applying such testing are discussed in the article.

NON-DESTRUCTIVE TESTING & INSPECTION AS BASED ON FACTORY & FIELD OPERATIONS

K.E. Rush

NDT
pp 30-32

Fall 1949

Discussion of 1) Dimensional inspection, 2) Superficial inspection, 3) Misc. inspection, 4) Physical properties of parts.

EDDY CURRENT TESTING - SAE J425

SAE Information Report
(Report of Iron and Steel Tech. Comm.)

June 1960

STANDARDS OF NDT

SNT

Soc. NDT, IA Section
Program, pp 26-47

1965-66

A listing of standard types of NDT and commonly used specifications and standards.

WATCH FOR THESE NEW NONDESTRUCTIVE TESTING TOOLS

Steel
pp 62-66

January 22, 1962

SURVEY TO DETERMINE THE AIR FORCE RESEARCH AND DEVELOPMENT
NEEDS IN THE FIELD OF NONDESTRUCTIVE TESTING

S.A. Wenk

WADC TR 56-607

June 1957

ASTIA Doc. No. AD 1308-48

The increasing complexity of air weapons systems has resulted in increased dependence on nondestructive testing as a means of assuring the conformance of aircraft materials and components to design criteria. This survey reviews the problems inherent in existing nondestructive testing methods, as well as those inspection problems for which no present nondestructive test is adequate. In addition, the shortage of skilled personnel, and the necessity of establishing training programs, is cited. (continued on back)

TEST IT, BUT DON'T BREAK IT

Dun's Review and Modern Industry
pp 50-53

January 1964

NDT methods used in industry, employing vibration, magnetism, radiation, optics and electronics are reviewed in light of the need for improving former testing techniques.

12. ULTRASONIC METHODS

INVESTIGATION OF METHODS FOR DETERMINING ACTUAL FLAW SIZE

L.J. Anderson

ASD-TR-61-205-II

September 1961

NASA
N64-14319

November 1963

The work effort under Contract AF 33(616)-7279 was directed toward the development and evaluation of techniques for determining actual flaw size, orientation and geometry in materials by nondestructive ultrasonic means. This has led toward the development of a practical prototype breadboard instrument which is capable of presenting an isometric projection of inconsistencies in metal parts. This development has been made possible through the design of a unique single oscillating transducer. To obtain the three dimensional pictures, a special mechanical manipulator and presentation system were designed and built. The special mechanical manipulator moves the transducer in a path which allows complete volumetric scanning (cont

THE GATED MODULATOR-A NEW WAY TO MEASURE SOUND VELOCITIES IN SMALL SAMPLES

D.L. Arenburg

Proc. of the IEEE
Vol 51 No. 2
(reprint)

February 1963

GENERATION, DETECTION AND MEASUREMENT OF ULTRASOUND

A. Barone

Handbuch der Physics

Acoustics II
pp 74-152 Vol 11/2

1962

In this article a general exposition of the production of ultrasound is given and some methods of measurement, based on the physical phenomena which accompany the propagation of ultrasonic waves of small amplitude are discussed. The physical effects produced by high energies and the use of ultrasound in the investigation of the molecular and structural properties of matter are dealt with in other chapters of this Encyclopedia.

INSPECTION AND TESTING OF HONEYCOMB AND HONEYCOMB
SANDWICHES

R.F. Blackwell

Bonded Aircraft Structures, CIBA
Dixford, Cambridge
pp 161-169

1957

U/S RESEARCH BEHIND THE IRON CURTAIN

R.M.G. Boucher

U/S News
pp 6-8

4th Quarter 1959

U/S FLAW DETECTION - A REVIEW OF FACTORS AFFECTING THE
SIGNIFICANCE OF RESULTS OBTAINED BY ECHO SOUNDING (French)

B.R. Byrne

Memoires Scientifique de la Revue de Metallurgia July 1959
pp 231-256 LVI No. 2

INVESTIGATION OF METHODS FOR DETERMINING ACTUAL FLAW SIZE IN
MATERIALS BY NONDESTRUCTIVE ULTRASONIC MEANS

L.J. Anderson, G.J. Posakony

ASD-TR-61-205, Part I

September 15, 1961

Progress Report No. 6
AF Contract AF 33(616)-7279, S2(61-1519)

Contract AF 33(616)-7279, S2 (61-1519) is a continuation of a previous program performed under Contract AF 33(616)-7279. These contracts are administered by Aeronautical Systems Division, Air Force Systems Command, United States Air Force. The work performed under Contract AF 33(616)-7279 is reported in ASD Technical Report 61-205. This new effort was directed toward optimizing the single transducer ultrasonic nondestructive flaw analysis system. This program will incorporate a unique high speed volumetric scanning system, a multiple display system, and will utilize coaxial transducers. ~~THIS REPORT IS UNCLASSIFIED~~

DEFECT ASSESSMENT USING ULTRASONIC WAVES

D.G.W. Claydon

Gordon & Breach Science Pubs., Inc. N.Y.
pp 167-187 Vol 2

1964

ULTRASONIC TESTING

D. Erdman

J.Soc NDT
pp 28-30 Vol 8 No. 2

Fall 1949

THE DEVELOPMENT OF U/S METHODS FOR MATERIAL TESTING IN POLAND

L. Filipczynski

NDT
pp 276-280

September - October 1959

THE WHAT AND HOW OF ULTRASONICS

P. Kaprielyan

Aircraft & Missiles Manufacturing
pp 6-12

September 1959

Cleaning, gaging, flow detection and machining are major uses; increasing specialized tasks in R & D stage.

EXCERPTS FOR 'SONIC AND ULTRASONIC WAVES IN AIR, WATER, AND SOLIDS'

V.A. Krasil'nikov

U.S. Joint Publications Research Service

January 1962

JPRS: 12018

ELECTRONIC RINGING - RESONANT SONIC TESTS

Magnaflux Corp.

Magnafacts, Vol 13 No. 3 p 11

Summer 1965

USES OF ULTRASONICS IN RADIO, RADAR & SONAR SYSTEMS

W.P. Mason

Proceedings of the IRE
pp 1374-1384

May 1962

A short historical review is given of the development of ultrasonics. Uses in the low-amplitude range are sonar systems, dispersive and nondispersive delay lines, ultrasonic inspectoscopes, and crystal and mechanical filters. In all of these applications, the very low internal friction of metals and fused silica provides very low losses, while the guided wave properties of various shaped transmission paths provide either dispersive or nondispersive transmission.

ULTRASONIC IN INDUSTRY

F. Massa

Proceedings of the IRE
pp 1385-1392

May 1962

The various industrial uses of ultrasound were qualitatively described. They were divided into three groups: (1) Low power which included flaw detection, thickness gauging, and friction reduction (2) Medium power applications such as Delay lines, and (3) High power applications such as reduction in grain size.

This article has some value as a report of what is currently being done in ultrasonics.

Pulse, Reson - Good Gen. Info.

U/S IN NDT.

W.J. McGonnagle

U/S News
pp 13-17

March 1958

ULTRASONIC ENGINEERING (After One Year)
(Re: Coupling, Transducers, etc.)

R.C. McMaster

News in Engineering

November 1963

INVESTIGATION OF METHODS FOR DETERMINING ACTUAL FLAW SIZE IN
MATERIALS BY NONDESTRUCTIVE ULTRASONIC TECHNIQUES

G.J. Posakony, M.R. Loetz

RADC-TR-59-302 (Contract AF 33(616)-5714)

July 1959

The investigation of methods to determine actual flaw size in materials by ultrasonic nondestructive techniques has led to the development of breadboard equipment capable

NONDESTRUCTIVE TESTING

Okla. State Univ. School of Chem. Eng. Stillwater Armed Services
Tech. Inf. Agency, AD 289555
pp 45-51

A basic treatment of the generation, use, and types of ultrasonic waves was presented. A qualitative description of longitudinal, transverse, and surface modes was included. The article provides an excellent introduction into the field of ultrasonic nondestructive testing.

ULTRASOUND IN INDUSTRY

R.G. Neswald

International Science and Technology
pp 28-39

February 1964

"When a powerful body of sound theory is finally matched by experimental advances, the result is a wealth of able tools. But when the uses outstrip theory and measurements, the result is apt to be chaotic."

DIFFERENCES IN U/S TESTING OF VARIOUS MATERIALS

J.B.Morgan

J. NDT p 121

Mar-Apr 1963

ULTRASONIC NONDESTRUCTIVE TESTS

R.C.McMaster (editor)

SNT Handbook of N/D Testing
Sec VI, Chapt 6.14
Carborundum Co., N.Y.

Mar 1958

SOME FACTORS OF IMPORTANCE IN U/S TESTING.

J.B. Morgan

NDT
pp 13-18

May-June 1964

In ultrasonic inspection, the amplitude or height of the indication from a metallurgical or mechanical defect, as displayed on a cathode-ray tube screen, generally determines the acceptance or rejection of the article being tested. Therefore, factors that affect this height are important, particularly when an attempt is made to estimate the size of a defect. This paper describes the results of an investigation to determine the effects of several factors in ultrasonic testing which are, perhaps, not generally recognized. The factors discussed are the distance of a discontinuity below the surface of the article; the geometry of the article; the frequency, size and sensitivity of the searching unit (transducer); and the performance of the ultrasonic instrument.

DEVELOPMENT OF ULTRASONIC TECHNIQUES FOR DEFECT EVALUATION

J.B. Ramsey, W.M. Rowe

N63-15710

February 1963

An experiment is described in which the effects of forming method and heat treatment on ultrasonic signal response in some newer alloys were investigated. In addition, specific acoustical impedance, attenuation values and shear and Rayleigh wave characteristics were studied. Rolled material was found to have a consistently higher response, transmission of ultrasound improved with heat treatment, and the effects became more pronounced as the test frequencies increased. Image conversion techniques were also investigated.

RESONANCE VIBRATION TESTS

R.G. Rowe

Contribution to SNT Handbook, Section VI, Chapter 6.14

Report discusses some of the basic theory of natural frequency testing as a method of detecting structural integrity. Descriptions and equations for the natural resonance behavior of equipment, techniques, and several applications are mentioned. The report definitely supports the natural frequency approach to testing honeycomb structures from only a single side.

DEVELOPMENT OF ULTRASONIC TECHNIQUES FOR DEFECT EVALUATION

R.R. Rowand (Proj. Eng)

ASD-TDR-62-8
(W-P AFB)

February 1963

The results of investigations to determine the effects of sever metallurgical and acoustical variables on the ultrasonic signal strength using commercially available ultrasonic flaw detection equipment are reported. Applied to various metals used in aerospace structures and components, these investigations resulted in the separation and determination of important acoustical properties that were expected to indicate the cause for differences in the transmission of ultrasonic energy in the various materials. A method was developed for applying correction factors to test blocks of one metal in order to estimate the size of defects in other metals. Beam collimation techniques were studied to determine optimum conditions for detecting defects and displaying them on both cathode ray (continued)

ULTRASONIC INSPECTION OF WROUGHT PRODUCTS

SID-62-227 NAA/Space & Information Division

A nine page pamphlet of diagrams of testing methods.

AN ELECTRONIC EAR FOR CERTIFYING RELIABILITY

R. Spain, N. Schubring, M. Diamond

Paper presented at Nat. SIME Convention ¹⁹⁶²
Natural frequency vibration tests were used to certify the quality of complex solid metal parts, for example, crankshafts. The natural frequencies were in the audio range and were either fundamental and/or harmonics. Analysis of the reverberation amplitude, decay rate, and frequency distribution were the factors that yielded information. The project definitely shows that the natural resonant frequencies of complex structures will yield information concerning the material integrity. Conventional electronic equipment areas used throughout the study. It appears that this approach should yield information concerning the presence of disbonds on either side of a honey-comb panel-when testing from only one side.

Cat: 12

U/S TESTS ASSURE SOUND PARTS

Steel (magazine)
pp 55-57

June 14, 1965

DO PEOPLE REALLY UNDERSTAND NONDESTRUCTIVE TESTING

H. Thielsch

Welding Design & Fabrication
pp 40-42

July 1962

Discussion of mass production testing, standards, field inspection
and weld quality.

SURVEY OF ULTRASONIC METHODS AND TECHNIQUES

S.A. Wenk

Symposium on NDT in the Field of Nuclear Energy ASTM Special
Publication April 16-18, 1957

No. 223

"The purpose of this paper is to furnish a background of basic
information in the field of ultrasonic nondestructive testing
for those not familiar with the field."

INDUSTRIAL ULTRASONICS IN THE U.S.S.R.

I. Woloshyn

Ultrasonics (magazine)
pp 14-26

January-March 1963

The author surveys the long and complex history of ultrasonics
in the U.S.S.R., describing, from the 19th century to the
present day, the growth of the science, its applications and
the organization of its research and development. The survey
is supported by a list of references which, though lengthy by
any standards, indicates only a part of the voluminous Russian
literature on the subject. The references are grouped according
to subject matter so as to be a guide to further detailed
information.

Cat: 12

13. RADIATIVE METHODS

"NAVY SEES PROMISE IN INFRARED THERMOGRAPHY FOR SOLID CASE
CHECKING"

W.S. Beller

Missiles and Rockets
pp 22-23

January 4, 1965

ADVANCEMENT OF THERMAL TEST METHODS IN NDT OF AIRCRAFT & MISSILE
COMPONENTS (HONEYCOMB)

J. Borucki

Metal Treating
pp 9-10, 12-14

June-July 1962

Reviews advancement in thermal NDT as applied to brazed honeycomb. Also discusses the Bondcheck Thermographic Process; its advances and its industrial applicability as an accurate, rapid, feasible means for nondestructively inspecting brazed honeycomb and similar applicable structures.

RADIOGRAPHY

FAA: Bureau of Flight Standards

Gov. Printing Office
QC Digest No. 4

June 1959

This digest deals with radiographic inspection as it is practiced today and offers basic information for FAA inspectors who evaluate radiographic techniques in manufacturing plants.

BONDHECK THERMOGRAPHIC TEST SYSTEM

Magnaflux Corp.

Magnaflux Form No. 16690-1, 1M, 1-64, MX
(bulletin)

APPLIED RESEARCH TO ESTABLISH INFRARED DETECTION METHODS FOR
NONDESTRUCTIVE ANALYSIS OF METALLIC AND CERAMIC STRUCTURES

D.R. Maley et. al.

Part II

ASD-TDR-62-385
Automation Industries, Inc.
Boulder, Colo.

August 1963

The second year's continuation of the program under Contract AF 33(616)-7725 has been devoted to further study of the feasibility of thermal nondestructive evaluation of materials. Emphasis has been on metals. A thermal testing system developed previously on the program was utilized to study material properties through the inspection of heat transfer rates. Heat introduced into the material establishes a heat transfer rate which is monitored by infrared radiometric surface temperature measurements. These temperature measurements are used to indicate certain material properties which have an effect on heat transfer. Properties detected to date are voids, (continued)

APPLIED RESEARCH TO ESTABLISH INFRARED DETECTION METHODS FOR
NONDESTRUCTIVE ANALYSIS OF METALLIC AND CERAMIC STRUCTURES

D.R. Maley, S.W. Maley

Part III

ASD-TRD-62-385
Automation Industries, Inc.
Boulder, Colo.

March 1964

The feasibility study on thermal nondestructive evaluation of materials has been continued. Various material properties or defects in samples have been evaluated by one or both of two basic testing methods, known as the scan heat technique and the heat support technique. Both methods operate on the principle that heat transfer rates through a material are dependent on the properties of the material and the presence of internal defects. Heat is introduced at the surface of a sample. Its transfer away from the surface into the sample is gauged by continuous monitoring of surface temperature with (continued)

AN INFRARED RADIOMETRIC MICROSCOPE FOR NDT OF
INTEGRATED CIRCUITS

R.B. McIntosh, Jr. & J.R. Yoder

Infrared Applications for NDT
Barnes Engineering (bulletin)

1964

RECENT DEVELOPMENTS IN THE RADIOGRAPHY OF HIGHLY RADIOACTIVE
SPECIMENS AT A.E.R.E., HARWELL

R.W. Parish, D.A.W. Pullen

British J. of NDT
pp 3-9

March 1965

The report describes techniques developed which make possible the radiography of highly radioactive materials. Projection radiography is used in each of the two methods described, and no elaborate or expensive equipment is used other than a standard 200 kV, half wave, 4mA, portable X-ray unit.

INFRARED OPTICS

Valpey Corporation

Transmission and absorption characteristics of typical infrared optical materials (bulletin - no date)

NEW TOOL FOR NONDESTRUCTIVE TESTING

Wen (magazine)
pp 142

August 1965

FEASIBILITY STUDY OF A NONDESTRUCTIVE TESTING INFRARED INSPECTION SYSTEM FOR BONDING FLAW DETECTION

P. Yetitto, R. Gorman

Interim Report No. 2 PE-TR-5959
Perkin-Elmer Corp.
Norwalk, Conn.

April 1961

This interim report details the results of work conducted on Contract No. DA-19-020-ORD-5243 for OMRO, Watertown Arsenal entitled "Feasibility Study and Development of a Nondestructive Testing Infrared Inspection System," covering the period 1 November 1960 to 30 April 1961. This document is an extra-contractual submission, and serves to explicitly establish the status of the program, with regard to accomplishments, direction and goals at this time.

INFRARED APPLICATIONS FOR NONDESTRUCTIVE TESTING

J.H. Yoder, R.B. McIntosh

Barnes Engineering
Stamford, Conn.

December 1964

14. ELECTRO-MAGNETIC METHODSPRINCIPALS AND APPLICATIONS OF MICROWAVES IN MATERIAL TESTING

R. Hochschild

Microwave Instruments Co. Bulletin 1000
Corona del Mar, Calif.

October 1964

ELECTROMAGNETIC METHODS OF TESTING METALS

R. Hochschild

Progress in NDT
pp 59-126 Vol. 1
The MacMillian Co. N.Y.

1959

A review of methods and theory concerning discrimination between variables as related to electromagnetic means of testing, with emphasis on the more important ideas and techniques.

CORONA DETECTION TECHNIQUES AS A NONDESTRUCTIVE METHOD FOR LOCATING VOIDS IN FILAMENT-WOUND STRUCTURES

E.W. Lindsay, C.N. Works

Standards for Filament-Wound Reinforced plastics
pp 273-276

The various corona detection circuits are reviewed and the feasibility of corona test methods as a nondestructive test for locating voids or flaws within filament-wound structures are discussed. The various types of corona detectors used for flaw detection, the present art in relating the size and shape of the void to the corona pulse characteristics, and the areas where investigation and development are necessary in order to perfect the test method are pointed out.

CORONA DETECTION TECHNIQUES AS A NONDESTRUCTIVE METHOD FOR
LOCATING VOIDS IN FILAMENT-WOUND STRUCTURES

E.W. Lindsay, C.N. Works

Standards for Filament-Wound Reinforced Plastics
pp 273-285

The various corona detection circuits are reviewed and the feasibility of corona test methods as a nondestructive test for locating voids or flaws within filament-wound structures are discussed. The various types of corona detectors used for flaw detection, the present art in relating the size and shape of the void to the corona pulse characteristics, and the areas where investigation and development are necessary in order to perfect the test method are pointed out.

SENSITIVE EDDY CURRENT TESTER IDENTIFIES DEFECTS

Metal Progress (magazine)
p 7

January 1964

INSPECTION PROCESS, MAGNETIC PARTICLE

Mil Spec MIL-I-6868C

February 1965

Specification covering general requirements and tests for performing magnetic particle inspection.

MECHANICAL MEASUREMENT-USE OF THE HALL EFFECT

M. Nalecz

Electronic Technology
pp 15-17

January 1961

A STUDY OF METHODS FOR MEASUREMENT OF THE PROPERTIES OF MATERIALS
AT MICROWAVE FREQUENCIES WITH EMPHASIS ON THEORIES FOR THE
EVALUATION OF MEASUREMENTS

G.K. Neiders

Thesis: Ohio State University

1959

The work described is related to techniques described by
Dr. F.J. Tischer in his book, MIKROWELLEN MESSTECHNIK...

PROGRESS REPORT ON N/D TESTING BY ELECTROMAGNETIC METHODS

C.J. Renken

ANL-6414 Argonne, Ill.
Argonne National Lab

July 1962

This report summarizes new developments and improvements in electromagnetic and eddy current test methods and equipment. It is meant to be a continuation and outgrowth of the work reported in ANL-5861, A Status Report in Eddy Current Theory and Application.

STATUS REPORT IN EDDY CURRENT THEORY AND APPLICATION

C.J. Renken et. al.

ANL-5861
Argonne National Lab
Lemont, Ill.

November 1958

This status report on Eddy Current Theory and Application summarizes new developments and improvements in nondestructive testing techniques by means of eddy currents. It represents the work of the type carried out by the Nondestructive Testing Group of the Metallurgy Division during the past two years.

Eddy current testing techniques are still in their infancy due to a lack of basic knowledge concerning eddy currents and the lack of adequate instrumentation. The information contained in this report will assist in supplying some of the basic knowledge and will be the basis for providing some of the needed instrumentation.

MICROWAVES: NEW VISTAS FOR GAGING, TESTING, ANALYSIS

Steel (magazine)
pp 60-61

July 20, 1964

NONDESTRUCTIVE BOND INSPECTION TEST BY ELECTRIC RESISTANCE
MEASUREMENT FOR COMPLETE FLAT-PLATE FUEL ELEMENT SUBASSEMBLIES

C.W. Weaver, etal.

Symposium on NDT in the field of Nuclear Energy ASTM STP-223
pp 286-293

As part of a Westinghouse Atomic Power Division (WAPD) program, a study was made of methods by which nondestructive inspections of the core-to-clad bonds in completed, flat-plate fuel assemblies could be made. Normally, these inspections are made on single fuel elements by frost testing or ultrasonic methods. However, none of these techniques, as usually applied, could be used on complete subassemblies because they are not usable in long thin passages. Therefore, it was necessary to develop a new inspection method.

Cat: 14

15. EQUIPMENT AND ELECTRONICS

PROCEDURES FOR TESTING U/S DELAY LINES

Bulletin TD(58) Re-
Arenberg U/S Laboratory

1959

This booklet deals with the use of ultrasonic test equipment, particularly with reference to ultrasonic delay lines. Since the procedures and programs are the same for other applications such as measurement of the basic mechanical properties of matter for theoretical purposes, determination of flaws for practical applications, this discussion will be of assistance to those being introduced to ultrasonics for the first time. For this purpose, a brief section relating to general applications will be included in a later discussion.

SELECTION OF ANALAB EQUIPMENT FOR U/S AND NUCLEAR MAGNETIC RESEARCH

Bulletin TE69
Arenberg U/S Laboratory
Jamaica Plain, Mass.

1964

LOW FREQUENCY INDUCTANCE TUNER, PG-650-C

Bulletins TE74, TE21, TE82, et al
Arenberg U/S Laboratory, Inc.
Jamaica Plain, Mass.

1964

TEST EQUIPMENT FROM ARENBERG U/S LABORATORY

Bulletin TE62-1
Arenberg U/S Laboratory
Jamaica Plain, Mass.

1965

CATALOG OF TECHNIQUES FOR MICROSYSTEM ELECTRONICS

P.B. Myers

Machine Design
pp 178-193

August 17, 1961

ULTRASONIC IMAGE

J. Powers

Research/Development Mag.
pp 24-27

November 1963

NDT EQUIPMENT AND APPLICATION

Bulletin 00-105
Sperry Products
Daubury, Conn.

1961

COMPUTER SPEEDS SURFACE PLATE INSPECTION

E.C. Varnum, D.L. Sherman

Tooling & Insp. Magazine
pp 82-85

June 1965

Concerns use of computer in relation to inspection of surface plates by optical methods.

16. MATERIAL RESPONSEINVESTIGATION OF NON-DESTRUCTIVE METHODS FOR THE
EVALUATION OF GRAPHITE MATERIALS

G.S. Lockyer

AFML-TR-65-113
(Air Force Materials Laboratory)
Avco Corp., Wilmington, Mass.

June 1965

The properties and behavior characteristics necessary for characterizing graphite as an ablative material for aerospace applications are identified, and applicable NDT methods and techniques are described and theoretically justified.

MCGARRY AND MARSHALL ON WIRE-WOUND COMPOSITES

McGarry

Standards for Filament-Wound Reinforced Plastics
pp 131-143MAGNETOABSORPTION TECHNIQUES FOR MEASURING MATERIAL
PROPERTIES

W.L. Rollwitz & J.P. Claassen

AFML-TR-65-17
Southwest Research Inst.

Apr 1965

Magnetoabsorption signals from ferromagnetic wires in superimposed slowly varying DC and RF magnetic fields are shown to be primarily dependent upon reversible permeability. This dependency has been verified experimentally.

REALISTIC APPROACH TO INSULATION TESTING

N. Scott, R. Steiner

Paper presented at the International Conference on Aerospace Support, Washington, 8 August 1963, in Technical Session 36.

An analysis of the history on dielectrics, followed by a review of the basic natural laws governing these materials resulted in a series of recommendations toward the realistic use and non-destructive testing of insulating materials.

17. PENETRANT AND MISCELLANEOUS METHODSPENETRANT INSPECTION

Commerce Dept. CAA

Quality Control Digest
No. 2

November 1958

Penetrant inspection has been developed as another nondestructive test method to help insure the use of only sound parts in new planes, and to locate damaged parts during the life of the plane so that catastrophic failures can be eliminated.

Penetrant inspection is not a cure-all for our defective material problem; but, if used properly, it will locate surface defects economically and accurately. Like all nondestructive testing, the success of this method depends on adherence to instructions, training of operators, development of standards, and the interpretation of indications.

PHOTOELASTIC NONDESTRUCTIVE INSPECTION OF TEFLON POSITIVE EXPULSION BLADDERS

R.S. Goldbert et. al

Research Memo
No. 1104
NAA/Rocketdyne

1964

This report describes the effort expended in developing a photoelastic inspection technique and applicable apparatus for Teflon expulsion bladder stress analysis to be used in acceptance testing of Gemini expulsion bladders. In scope, the report relates the work conducted on SE-6 and SE-7 Teflon expulsion bladders. However, the information, technique, and apparatus resulting from the subject effort is applicable to numerous stress analysis applications of plastic film materials.

100% EVALUATION TESTING...AT RAYTELON

Magnaflux Corp.

Magnafacts, Vol 13 No. 3 pp 4-5

Summer 1965

Use of Zygo for primary inspection of semi-conductors.

TEST UNIT STILL PAYING DIVIDENDS**Magnaflux Corp.****Magnafacts, Vol 13 No. 3 pp 8-9****Summer 1965**

Use of Magnaflux equipment for QC of various types of chain in chain manufacturing plant.

PAVIA'S MODERN FOUNDRY**Tooling & Production
p 190****Sept 1965**

Brief description of a modern foundry in Pavia, Italy which uses u/s inspection equipment.

NDT PAYS ITS WAY IN MAINTENANCE, TOO**C.J. Vlahos****Mill & Factory
pp 60-61****August 1965**

No longer restricted to production, nondestructive testing is now cutting maintenance costs - in preventing expensive and dangerous failures of equipment and machinery.

18. BIBLIOGRAPHIES

THE APPLICATION OF NDT TO PLASTICS

A.M. Anzalone

Plastic Technical Evaluation Center
PB-171810

July 1961

The literature has been search for documents which provide information on nondestructive testing techniques as applied or which are applicable to plastics. In a field of effort in which the past few years have seen marked advances, this search must be considered a status-report.

The items located fall roughly into two groups: those techniques which involve ultrasonics and those which do not. This has given basis for the method of presentation, in which Part I covers 25 references on the ultrasonic techniques and Part II presents 16 references on the non-ultrasonic approaches. Other related information not available in report form is presented in Part III.

PHYSICS OF ULTRASONICS AND HYPERSONICS IN SOLIDS AN ANNOTATED
BIBLIOGRAPHY

A.A. Beltran

Special Research Bibliography SRB-60-9
Lockheed Missiles and Space Div., Sunnyvale

September 1960

Ultrasonic and hypersonic radiation ranging from several megacycles to above 1000 megacycles; its generation, detection and propagation in solids is covered in this annotated bibliography. Piezoelectric sources of ultrasonic radiation; optical, mechanical and electrical methods of detection; measurement equipment, methods and results; and propagation, attenuation and absorption are included.

A REVIEW OF U/S IMAGING METHODS w/BIBLIOGRAPHY

H. Berger, R.E. Dickens

ANL-6680

July 1963

Methods for detecting ultrasonic images in nondestructive testing systems were presented and compared from the standpoint of threshold sensitivity. Photographic and chemical methods, thermal effects, optical and mechanical techniques, and electronic methods were considered. It was found that a detector should be capable of responding to ultrasonic intensities of $10^{-3}w/cm^2$ to be of practical use. Electronic methods were concluded to be the most promising detection method.

Aside from the valuable optical scanning information in this article, the selected annotated bibliography provides a fund of references.

NONDESTRUCTIVE TESTING

C. Briggs

Martin Company Lit Search
No. 15

July 1962

A bibliography of articles and reports on Nondestructive testing for the years of 1961 - 1962.

HONEYCOMB BIBLIOGRAPHY, 1960-61

Hexcel Products

TSB-118
Hexcel Products
Berkeley, Calif.

June 1962

ULTRASONIC PHENOMENA AND METHODS OF MEASUREMENT: A BIBLIOGRAPHY

C.A. Komar, J. Pasini

Information Circular 8146
United States Department of the Interior
Bureau of Mines

1963

<p>DEUTSCHE FORSCHUNGANSTALT FUR LUFT-UND RAUMFAHRT</p> <p>H. Meckelburg, W. Althof</p> <p>DFL-216 Germany</p>	1963
<p>SHOCK AND VIBRATION ENGINEERING-VOL I</p> <p>C.T. Morrow</p> <p>John Wiley & Sons, New York-London</p> <p>Abstracted in Acustica Bookreviews p 237 Vol 14</p>	1963 1964
<p>SANDWICH STRUCTURE AND LAMINATED STRUCTURE: A LITERATURE SEARCH CONDUCTED ON THE NASA SEARCH SYSTEM</p> <p>J.H. Okuda</p> <p>NAA/LAD Report No. 63-1298</p>	November 1963
<p>SCIENTIFIC ACTIVITIES OF THE INSTITUTE OF BASIC TECHNICAL PROBLEMS OF THE POLISH ACADEMY OF SCIENCES IN 1961</p> <p>R-1961 Poland</p>	1963
<p>ULTRASONIC INSPECTION</p> <p>SAE Information Report SAE J428</p> <p>Report of Iron & Steel Technical Committee approved June 1960.</p>	

ULTRASONIC MEASUREMENT: A BIBLIOGRAPHY

S&ID 63-168

S&ID Accession No. 17982
NAA/SID

1963

This report is a bibliography of periodical articles on ultrasonic measurement published in English during the years 1953-1962.

NONDESTRUCTIVE TESTING OF ADHESIVE BONDED JOINTS: A PARTIALLY ANNOTATED BIBLIOGRAPHY

S&ID

SID 62-26

January 1962

This report is a survey of the literature on the nondestructive testing of adhesive bonds. Most of the items listed are technical reports and refer to ultrasonic testing methods. The period covered is from 1947 to July 1961.

BIBLIOGRAPHY: PROPAGATION OF HIGH FREQUENCY STRESS WAVES IN SOLIDS

R. Truell

No. 50-301
Metals Research Lab
Brown Univ. Providence, R.I.

January 1962

19. SYMPOSIA

SECOND SYMPOSIUM ON PHYSICS AND NONDESTRUCTIVE TESTING

R.A. di Novi

ANL-6515 (Argonne National Laboratory)

1961

The uses of positive-ion accelerators and neutron sources for material evaluation and analysis are described in terms of basic experimental results obtained on a variety of problems. Surface and volume activation techniques are appraised from data as well as from theoretical considerations. Problems of neutron and radioactivity detection are discussed from the viewpoint of reduction to practice in the industrial laboratory.

IEEE CONVENTION RECORD, PART 9

IEEE

IEEE, New York, N.Y.

Marcy 1963

Covering Bio-medical electronics, Geoscience electronics, Ultrasonics engineering.

IRE CONVENTION RECORD, PART 6

IRE

IRE, New York, N.Y.

1962

Covering U/S welding, machining, cleaning and wide band spectrum analysis.

SYMPOSIUM ON TESTING ADHESIVES FOR DURABILITY AND PERMANENCE

STP
No. 138

June 1952

An effort has been made to obtain specific data on the relationship between the apparent behavior of wood adhesives in permanence tests and the construction of the test specimens. Outdoor exposure and laboratory water-immersion air-dry cycling procedures, with the aid of phenolic or resorcinol resins were used to study this relationship. Brief attention has also been given to recalling the interdependence of construction of plywood test specimens and maximum tensile shear strength, as established by the Forest Products Laboratory years ago.

2. U/S METHODS AND EQUIPMENT

21. TRANSDUCERS AND COUPLANTSVARIABLE ANGLE TRANSDUCER WHEELS

Branson Instruments, Inc.
Stamford, Conn.

Bulletin T-222B

February 1964

PRELOADING OF ACOUSTIC TRANSDUCERS FOR HIGH PRESSURE OPERATION

A.D. Brickman

J. Acoustical Soc. America
pp 305-311 34 No.3

March 1962

The characteristics of a piston-type transducer that must withstand varying hydrostatic pressures can be improved by mechanically preloading the assembled transducer prior to operation and by carefully matching the axial compliances of the individual elements. A simple analysis and some tests of an experimental preloaded transducer are described, and the particular advantages of conical disk springs as transducer isolators are discussed.

GENERATING ULTRASONICS AT MICROWAVE FREQUENCIES

W. Brouillette, W. Stephen

Electronic Industries Magazine
pp 93-95

November 1963

Concerning methods and problems involved in generating and handling microwave sounds in the gigacycle range.

PRODUCTION AND PROPERTIES OF HIGH INTENSITY ULTRASONICS

B. Brown

Industrial Electronics
pp 44-46

January 1964

PIEZOELECTRICITY AND ULTRASONICS

W.G. Cady

Sound
pp 46-52 Vol. 2 No. 1

January-February 1963

PIEZOELECTRIC AND ELECTROSTRICTIVE TRANSDUCERS

W.G. Cady

Wescon Proceedings
pp 18-21 Vol. 1 Part No. 9

1957

A non-technical account is given of the general characteristics of piezoelectric transducers. The types used in sonar, in research on the acoustic properties of materials, and in various other applications, both resonating and non-resonating, are described. Special attention is given to the uses of barium titanate ceramics. There follows a discussion of electrostriction, with special reference to the recently developed electrostrictive relay.

VIBRATION MEASURING APPARATUS

J.S. Arnold, J.G. Martner

U.S. Patent Office
No. 3,121,327

February 18, 1964

NEW DEVELOPMENTS IN U/S TRANSDUCERS & THEIR APPLICATION TO NDT

J.P. Bacon

NDT
p 184

May-June 1961

The theoretical and practical application of new crystalline materials for ultrasonic flaw detection are discussed. Factors which influence resolution and sensitivity; establish the need for compensating and matching networks, and govern the design requirements of the pulser and receiver are outlined. Also a new "Delta" type transducer having operational capabilities over the frequency range of 30 kc to 5 megacycles is discussed.

RECENT DEVELOPMENTS IN FERROELECTRIC TRANSDUCER MATERIALS

D. Berlincourt

IRE Prof. Group on U/S Engineering, Transactions

1959

TRANSDUCER PROPERTIES OF LEAD TITANATE ZIRCONATE CERAMICS

D. Berlincourt et al

IRE Convention Record pt. 6
pp 227-240

1959

Physical properties of two commercial ceramics of the lead titanate zirconate family are presented and are compared with data for typical barium titanate ceramics. The importance of dielectric losses is stressed. Preference is given to showing heat generated as a function of nonresonant strain amplitude rather than electric-field amplitude. In this type of presentation, common barium titanate ceramics vary little from each other, while lead titanate zirconate ceramics are quite outstanding.

EXCITATION AND ATTENUATION OF HYPERSONIC WAVES IN QUARTZ

H.E. Bommel, K. Dransfeld

The Physical Review
pp 1245-1252 Vol. 117 No. 5

March 1960

A method for the generation and detection of hypersonic waves, which has only been briefly described earlier, together with some absorption measurements in quartz, is discussed in some detail. Further measurements of the hypersonic absorption in quartz at different crystal orientations and after neutron irradiation are reported. The results are in qualitative agreement with a phonon-phonon relaxation process.

A TUNED CAPACITIVE DETECTOR FOR HIGH FREQUENCY VIBRATIONS

P.G. Bordoni, M. Nuovo

Acustica
pp 351-362 Vol. 8

1958

A new apparatus for studying the longitudinal vibrations of plates in the megacycle range has been developed using an electrostatic drive and detector. The mechanical vibrations are converted to an a-c signal by means of a d-c polarising voltage applied to the probe as is normally done for electrostatic microphones.

The detection circuit is tuned on the vibration frequency; in this way a high sensitivity has been obtained. Detailed information is given on the circuitry and on upper frequency limits for the application of the apparatus in the measurement of the mechanical properties of plates. ~~Acustica~~

A NEW TYPE DIRECTIVE SOUND SOURCE FOR LONG RANGE SONAR

D.E. Church

Wescon Proceedings
pp 4-12 Vol. 3 Part No. 6

1959

This paper describes a new type of underwater, low-frequency sound source which is analogous to the highly directional end-fire antenna array. The sound source is in the form of a long thin rod which radiates sound energy into the water by means of axially symmetrical waves travelling in the direction of the rod axis. The rod is designed so that the phase velocity of a compressive wave is equal to the acoustic velocity in the surrounding medium. Acoustic energy is coupled into the rod from a driving transducer mounted at one end. Under ONR sponsorship, a 10-kc model of the sound source was designed and tested.

LAUNCHING ULTRASONIC SHEAR WAVES INTO SOLIDS AT NORMAL INCIDENCE BY PRESSURE COUPLING

D.I. Crecraft

J. Sound Vib. I (4)
pp 381-387

1964

The launching of ultrasonic shear waves generated by a crystal transducer into a solid medium is discussed, and the method whereby the transverse oscillations are coupled from the transducer to the medium by the application of a steady mechanical pressure is more particularly examined. The mechanical design of a single-crystal transducer, and of a four-crystal transducer which enables perpendicular planes of polarization to be readily selected, is discussed, together with methods of applying the steady pressure (which is typically about 20,000 lb/in²). The design of a shear wedge which permits the axis of polarization of a transducer to be readily determined is also given.

PIEZOELECTRIC TRANSDUCERS YIELDS ULTRA HIGH WAVES

J. deKlerk, E.F. Kelly

Steel Magazine
p 151

September 14, 1964

SCIENTIFIC-TECHNICAL CONFERENCE ON PHYSICAL METHODS FOR THE NON-DESTRUCTIVE TESTING OF MATERIALS

D.B. Dianov

Akusticheskii Zhurnal
pp 394-396 Vol. 7 No. 3

July-September 1961

A REVIEW OF PROGRESS MADE IN THE DEVELOPMENT OF VIBRATING SAMPLE AND VIBRATING COIL MAGNETOMETERS

D. Feldmann, R.P. Hunt

Air Force Materials Laboratories ML-TDR-64-306 December 1964
W-P AFB

The authors are engaged in research on ferro- and ferrimagnetic materials and their magnetic anisotropies. In the course of their investigations they both built or modified a vibrating sample magnetometer. During this work they performed extensive literature surveys in this area. This report combines the effort of both authors in reviewing the development of vibration magnetometers up to the current date.

NEW TYPES OF U/S TRANSDUCERS - TWO U/S TRANSDUCERS USE CADMIUM-SULFIDE*

N.F. Foster

Electronic Design
p 103
*included, p 133

April 13, 1964

APPARATUS FOR THE DETECTION OF PIEZOELECTRIC COUPLING

L. Frenkel

Journal of Research
pp 197-199 Vol. 67C No. 3

February 1963

An apparatus for the investigation of the piezoelectric coupling in granular powders is described. The apparatus is based on the method of Giebe and Scheibe but employs the sensitive detection and recording methods commonly employed in the study of nuclear quadrupole resonances. Some sample recorder traces are shown. The traces indicate that the apparatus is a workable qualitative tool with at least the possibility of some quantitative usefulness.

A REVIEW OF PROGRESS MADE IN THE DEVELOPMENT OF VIBRATING SAMPLE
AND VIBRATING COIL MAGNETOMETERS

D. Feldman, R.P. Hunt

ML-TDR-64-306
Mass. Inst. Tech.

December 1964

This report reviews the development of vibrating coil and vibrating sample magnetometers. The measuring principle is compared with other methods of measuring magnetization. The principal advantages of the oscillatory method are shown as well as the main aspects which have to be considered if one wishes to build such an instrument. Twenty-nine references are included.

U/S INTENSITY GAIN BY COMPOSITE TRANSDUCERS

W.J. Fry, F. Dunn

J. Acoustical Soc. America
pp 188-192 34 No. 2

February 1962

The radiation of plane acoustic waves into a medium by composite layered transducers composed of a piezoelectric element and two lossless coupling media is described analytically. The increase in acoustic intensity in the medium receiving the radiation produced by the composite structure over that produced by direct coupling (piezoelectric element in contact with the medium), for the same value of the electric field strength, is considered quantitatively and the results are presented graphically. Composite transducers of the type described can be expected to achieve considerably higher ultrasonic intensities (1000-fold increase) in both unfocused and focused beams than have heretofore been realized.

Cat: 21

POINT CONTRACT TRANSDUCERS FOR ULTRASONIC TESTING

O.R. Gericke

Watertown Arsenal Laboratories, Watertown 72, Mass.
 Report No. WAL TR 143.5/1
 pp 9 - illus.

June 1962

The feasibility of employing point shaped ultrasonic transducers which directly amplify the detected ultrasonic signal was investigated. Two approaches were considered, one used a semiconductor point with a depletion layer at the very tip produced by a bias voltage, the other employed the variation of contact resistance with contact pressure. The latter method was explored experimentally and found suitable for the detection of ultrasonic energy. In addition, experiments are described in which high-frequency sparks were produced at the specimen surface to generate ultrasonic vibrations.

A METHOD FOR DEFECT DISCRIMINATION IN AUTOMATIC MULTIPLE TRANSDUCER INSPECTION SYSTEMS

W.A. Gunkel

Material Evaluation
 pp 80-84

February 1964

A system of four transducers and nine channels which had been used for flaw detection and discrimination on pipes was described. Because each channel provided different information concerning the defect, it was possible to determine not only the location of the flaw but also the size and the type of flaw.

EFFECTS OF EXTRANEOUS MEDIUM UPON THE SENSITIVITY OF DEFECT DETECTION BY U/S

A.K. Gurvich

Zavodskaya Laboratoriya
 pp 1102-03 (Russian) Vol. 26 No. 9
 pp 1177-78 (English)

September 1960

EXPERIMENTAL TECHNIQUES USED IN UNDERGROUND EQUATION OF STATE
MEASUREMENTS

W.H. Gust, B.L. Hord

University of California UCRL - 7931

Lawrence Radiation Laboratory

July 1964

Critical analysis of the geometric and operational characteristics of a system used for making underground contained equation-of-state measurements is presented. Equation-of-state parameters for a well-known material were measured within uncertainties of less than 1 percent. Adequate shock pin reports were recorded for about 99 percent of the pins used.

MAGNETOSTRICTIVE TRANSDUCER DOUBLES U/S EFFICIENCY

Iron Age
pp 98-99

November 20, 1958

ANGLED SOUND WAVES FIND FLAWS

The Iron Age (magazine)
p 87

February 13, 1964

TRANSDUCERS FOR SONIC FATIGUE MEASUREMENTS

R.D. Kelly

Tech Report AFFDL-TR-64-171
W-P AFB

February 1965

This report discusses the machine errors of transducer systems used for the measurement of dynamic input and response data during sonic fatigue testing. The specific types of transducers covered are accelerometers, microphones, and strain gages. The basic operating principles, intrinsic inaccuracies, environmentally related inaccuracies, and usage inaccuracies are described. These inaccuracies are broken down into errors occurring in the transducer, cabling, and signal conditioner, as well as those due to system operation. In addition, methods for minimizing these errors are given.

STRAIN GAUGE MEASUREMENT OF OUTPUT OF MAGNETOSTRICTIVE U/S TRANSDUCER
PITFALLS OF OPTICAL MEASUREMENTS

H. Lamport, H.H. Zinsser

J. Acoustical Soc. America
pp 435-438 31 No. 4

April 1959

An easily fabricated, bifilar wire strain gage wound helically about the hilt of an U/S magnostriptive transducer measures amplitude and is more convenient than optical methods. Pitfalls in the usual optical method are illustrated and discussed.

THE TRANSMISSION EFFICIENCY OF LIQUID COUPLANTS ON ROUGH SURFACES
WHEN USING LONGITUDINAL WAVES

J.D. Lavender

Journal B.S.C.R.A.
No. 73

June 1963

Concerning testing of couplants used in U/S testing by means of contact scanning techniques.

SPECIFICATION FOR A STUDY OF THE FUNDAMENTAL CHARACTERISTICS OF
ULTRASONIC TRANSDUCERS

NAA/LAD Report
No. LA-63-141-8

May 1963

RECIPROCITY CALIBRATION OF ELECTROACOUSTIC TRANSDUCERS IN THE TIME
DOMAIN

A.F. Niemoeller

J. Acoustical Soc. America
pp 1712-1719 Vol. 33 No. 12

December 1961

A method of directly evaluating the impulse response of a reciprocal electroacoustic transducer is presented. The method is essentially the time-domain analog of the conventional (frequency-domain) reciprocity method. The transient response of a coupled pair of identical transducers is used to compute the impulse response of either of the pair. A numerical method of obtaining a solution is presented and is shown to be equivalent to the numerical solution of a real convolution integral equation.

A NOVEL MAGNETOSTRICTIVE U/S "JACK-HAMMER" TYPE ROTATING DRILL FOR BORING SMALL HOLES IN HARD MATERIALS

N.K. Marshall

Wescon Proceedings
pp 18-21 Vol. 1 Part No. 9

1957

A new technique for ultrasonic drilling of precision small-diameter holes in glass-hard materials such as ceramic magnets and ferrite cores is described and demonstrated. A specially shaped waveform is used to drive a magnetostriction transducer at an operating frequency of 28 kc/sec to produce a novel rotating "jack-hammer" action which speeds up the drilling process and increases the accuracy of the finished hole.

A BARIUM TITANATE TRANSDUCER CAPABLE OF LARGE MOTION AT AN ULTRASONIC FREQUENCY

W.P. Mason, R.F. Wick

J. Acous Soc Amer
pp 209-214 Vol. 23 No. 2

March 1951

By using a barium titanate cylinder poled radially a lengthwise motion can be excited in the cylinder whose resonant frequency is controlled by the length of the cylinder. By using a 4 percent lead titanate-barium titanate combination, stresses up to 1000 pounds per square inch of cross-sectional dimension and motions up to 50 parts in 10^6 times the length of the cylinder are available for static or slowly varying voltages of 15,000 volts per centimeter along the radial dimension. When such a cylinder is driven at its resonant frequency, the maximum strain appears to be limited to 10^4 by heating considerations if no cooling is used.

EFFICIENT LOW COST U/S TRANSDUCERS FOR USE IN REMOTE CONTROL AND CARRIER FREQUENCY APPLICATIONS

F. Massa

IRE Int. Convention Record
pp 243-245 No. 8 pt. 6

1960

A small efficient U/S transducer is described which incorporates a specially electroded piezoelectric disc bonded to a second plate.

THE MEASUREMENT OF DELAY-LINE TRANSDUCER RESISTANCE

J.J.G. McCue, J.A. Leavitt

IRE National Convention Record
pp 143-146 Part 2

1958

Discussion dealing with three methods for measuring transducer resistance: the variable external shunt, the Q-meter, and the admittance bridge.

A METHOD OF IDENTIFICATION, MEASUREMENT, AND RECORDING ULTRASONIC TRANSDUCER CHARACTERISTICS

J.T. McElroy

Automation Industries Technical Report 64-22

June 1964

A method is described whereby the frequency, damping, acoustical impedance, and beam symmetry of ultrasonic transducers can be accurately measured. The system consisted of pulse excitation of the transducer and analyzing the out put on an oscilloscope.

This method might be good for obtaining the characteristics of any transducers we design.

PERFORMANCE OF HIGH FREQUENCY BARIUM TITANATE TRANSDUCERS FOR GENERATING U/S WAVES IN LIQUIDS

H.J. McSkimin

J. Acoustical Soc. Of America
pp 1519-1522 Vol. 31 No. 11

November 1959

A study is made of high frequency barium titanate transducers radiating into water, with band width and efficiency being of principal concern. Focusing radiators, as well as plane, were tested.

J.B. Morgan

Iron Age
pp 131-135

August 6, 1953

Results are comparable to immersion method without immersing the work. Defects but $\frac{1}{8}$ in. below the surface of aluminum are detected. The device consists of a water column in plastic tube with or without metal diaphragms.

SHIFT IN THE LOCATION OF RESONANT FREQUENCIES CAUSED BY LARGE ELECTROMECHANICAL COUPLING IN THICKNESS-MODE RESONATORS

M. Onoe et. al.

Journ. Acoust. Soc. Amer.
p 36 Vol. 35

1963

The fundamental and overtone resonant frequencies of a thickness-mode, piezoelectric resonator depart from an integral-multiple relationship when the electromechanical coupling of the resonator material becomes large. An important practical application of this anharmonicity is in the determination of the coupling factor from the ratios of the measured fundamental and overtone resonant frequencies. For this purpose, roots of the frequency equation are tabulated for values of mode number ranging from 1 to 4 and of coupling coefficient ranging from 0 to 0.99 in intervals of 0.01.

CAVITATION EROSION OF SONIC RADIATING SURFACES

H.F. Osterman

IRE National Convention Record
pp 213-218 Part 6

1959

Discussion concerning the problem incident to maintaining high levels of efficiency and performance in U/S installations as regards cavitation erosion.

AUTOSONICS - PROBLEMS AND EXPERIENCES IN AUTOMATIC PRODUCTION TESTING

G.A. Rankin

Materialprüfung
pp 421-428 Bd. 2 No. 11

November 1960

LAMB WAVE SEARCH UNIT

Sales Data Sheet
pp 50-227

October 1958

A search unit is described which generates Lamb Waves for the inspection of discontinuities close to the surface. In particular, mention was made of the method's ability to test and reveal shallow laminar type defects such as those that exist in honeycomb to sheet bonds, thin sheet laminates, flat plates, etc.

WHERE ULTRASONIC TRANSDUCERS ARE TODAY

Dr. E. Sittig

Electronic Industries (magazine)
pp E2-E5

June 1963

A qualitative discussion on the types of transducers, applications of transducers and the limitation of transducers was presented. Piezoelectric, ferroelectric and magnetostrictive transducers were considered. A good discussion of the basics of transducer technology is presented.

WAYS TO INCREASE THE RESOLUTION OF U/S FLAW DETECTORS

D.S. Shraiber & B.G. Golodaev

Zavodskaya Laboratoriya
Vol 28 No. 1 pp 60-66
(English translation)

Jan 1962

It is shown that the methods for increasing the resolution of an U/S flaw detector are to decrease length of the driving pulse and duration of the free vibrations. The proposed method of obtaining pulses of various lengths and widths... is based on a time selective electrical compensation of the free vibrations in an undamped piezo cell during emission with a subsequent electric or acoustic compensation during reception.

SURFACE WAVE SEARCH UNIT**Sperry Products****Sales Data Sheet
50-208****August 1954**

A transducer is described which generates surface waves in metals. The surface waves will detect discontinuities on the surface or just below of distances of up to 10 feet. The theory of operation is briefly described. The transducer may be of use in honeycomb testing.

BONDING METHODS & A BONDING CLAMP FOR U/S MEASUREMENTS**P.F. Sullivan****J. Acoustical Soc. of America
pp 1879-1882 Vol. 34 No. 12****December 1962**

The results of an experimental investigation into the techniques of coupling the transducer to the specimen in making ultrasonic measurements are presented. Two major couplants, glycerine and phenyl salicylate, were subjected to tests. As a result of these tests, a bonding clamp was developed that greatly increased the reproducibility and accuracy of the measurements. •

INCREASING BANDWIDTHS OF U/S RADIATORS**H.M. Thaxton, O.L. Gallagher****Electronics
pp 60-62 Vol. 35 No. 27****July 6, 1962**

Signal-to-noise ratio is improved by propagating Rayleigh U/S waves.

EFFECT OF ELECTRICAL & MECHANICAL TERMINATING RESISTANCES ON LOSS AND BANDWIDTH ACCORDING TO THE CONVENTIONAL EQUIVALENT CIRCUIT OF A PIEZOELECTRIC TRANSDUCER

R.N. Thurston

IRE National Convention Record Part 6
pp 260-268

1959

The paper includes a rather complete analysis of transducer loss and bandwidth as a function of the mechanical and electrical terminations. The case of a series tuning inductor is treated by making use of an approximate correspondence with the shunt case. Results to be expected without a tuning inductor are also indicated.

ELECTROMECHANICAL COUPLING AND COMPOSITE TRANSDUCERS

W.J. Toulis

J. Acoust. Soc. Amer.
pp 74-80 Vol. 35 No. 1

1963

Measurements with composite types of transducers indicate that both the classical definition of the electromechanical coupling factor and the equivalent circuit for a piezoelectric transducer require revisions for improved consistency. The effective coupling coefficient depends on the proportion of the piezoelectric material that is employed electromechanically rather than being independent of it as implied by existing definitive formulations.

EFFECT OF LACK OF PARALLELISM OF SAMPLE FACES ON MEASUREMENT OF U/S ATTENUATION

R. Truell, W. Oates

J. Acoustical So. America
pp 1382-1386 Vol. 35 No. 9

September 1963

The measurement of ultrasonic attenuation and velocity at megacycle frequencies demands that the sample faces be parallel within limits that require extreme care. The importance of maintaining the tolerances in question is shown in terms of the echo patterns for various cases in which the tolerances are held and in which they are not. At the highest frequencies attained thus far (i.e., about 25 000 Mc/sec) with ultrasonic stress waves, the limits on parallelisms are so severe that there are at present no instruments capable of making the necessary measurements to control the sample parallelism.

NEW HIGH POWER MAGNETOSTRICTION TRANSDUCERS

U/S News
pp 14-15

October 1957

This paper discusses the design of three new high-efficiency magnetostriction transducers ranging in power-handling capacity from 50 watts to 1600 watts continuous input. Complete experimental performance data are shown which indicate over 40 per cent actual conversion of electrical input into measured acoustic power.

ULTRASONOSCOPE BULLETIN

U/S Probes
Sheet No. 1 and No. 2

1963

Listings and tables covering standard and selected U/S probes.

VIBRATION MEASUREMENT

I. Vigness

(source unidentified)
pp 1-15/15-28 Chpt. 15

TRANSDUCER MARKET ANALYSIS

G. VonVick . . .

Instruments & Control Systems
pp 117-119 Vol. 38

January 1965

Discussion of problems associated with the selection, design and marketing of a new transducer.

PIEZOELECTRIC PROBES FOR IMMERSION ULTRASONIC TESTING

D.C.B. Walker, R.F. Lamb

Applied Materials Research
pp 176-183

July 1964

Discussion of the properties of various piezoelectric crystals available for manufacture of U/S probes. Material properties are evaluated and methods of collimating or focusing probes are illustrated by reference to a particular application.

PROPERTIES OF PIEZOELECTRIC MATERIALS

W.D. Wedlock

Army Mat'l Res. Agency AMRA MS 64-05

June 1964

The purpose of this monograph is to provide a source of data on a wide variety of piezoelectric materials which will be useful to those conducting research in this area as well as to the engineer designing ultrasonic transducers, filters, and other piezoelectric devices. The numerical data are given in the rationalized MKS system in accordance with the IRE Standards on Piezoelectricity, as are the symbols employed.

DEPLETION LAYER TRANSDUCER - A NEW HIGH FREQUENCY U/S TRANSDUCER*

D.L. White

IRE Convention Record

1961

pp 304-309 Vol. 9 Part 6

*Also reprinted in IRE Transactions on U/S Engrg.

July 1962

pp 21-27

The depletion layer transducer is an ultrasonic transducer for use at UHF and microwave frequencies. Its potential advantages are high efficiency, large bandwidth, and comparative simplicity in fabrication. The region which generates or detects the ultrasonic waves is a thin flat high-resistance depletion layer, such as a p-n junction or a rectifying metal to semiconductor contact, in an extrinsic piezoelectric semiconductor. When an ac voltage is applied to the material, the depletion layer behaves in a manner similar to an extremely thin piezoelectric crystal bonded to the conducting substrate. ~~Since the depletion layer can (continued)~~

DESIGN OF NICKEL MAGNETOSTRICTION TRANSDUCERS

B.A. Wise

International Nickel Co. Inc. (N.Y.)

1960

Summary of experience in design of special transducers employing magnetostrictive properties of nickel.

HIGH-FREQUENCY ELECTROSTATIC TRANSDUCERS FOR USE IN GASES

W.M. Wright

1962 IRE International Convention Record, Part 6
IRE Part 62-6

March 1962

Discussion of transducer design, theoretical results, experimental characteristics, and applications.

Cat: 21

22. SCAN AND RECORD SYSTEMS
 AN ULTRASONIC SCANNER AND RECORDING SYSTEM*

W.N. Beck

Symposium on NDT in the Field of Nuclear Energy 8/16-18/57

ASTM Special Publication No. 223

April 1957

* Condensed version of this article appears in January-February 1957 copy of NDT magazine, pp 42-43.

Description of an U/S scanner developed at Argonne Nat. Lab., to handle large items on a production volume basis.

USES OF STATISTICAL METHODS FOR ULTRASONIC INSPECTION PROBLEMS

M.J. Bratt

Nondestructive Testing
 pp 282-287

September-October 1957

Basic concepts of statistics are outlined. Examples are given to illustrate the use of statistical methods in analyzing data obtained in typical test problems.

ULTRASONIC FLAWPLOTING EQUIPMENT-A NEW CONCEPT FOR INDUSTRIAL INSPECTION

R.W. Buchanan, C.H. Hastings

Nondestructive Testing
 pp 17-25

October 1955

The results are presented of an evaluation of the Ultrasonic Flaw Plotting Equipment, a device which involves in combination such novel features as modulated water stream acoustic coupling, plan and cross-section view pictorial presentation of flaw images, and a manually operated search scanner capable of coping with a wide variety of specimen geometry.

**U/S INSPECTION USING AUTOMATIC RECORDING & FREQUENCY MODULATED
FLAW DETECTOR.**

D.C. Erdman

Nondestructive Testing Magazine
pp 27-31

November-December 1963

In this paper an attempt has been made to show the requirements for a complete description of internal flaws; the depth to the flaw and its area or boundaries should be presented by organized data collected from two scans or views of the part. The area or boundaries can be given in a plan view as though one were looking down on top of the part and flaw. The "B" scan or cross-section view shows the position of the flaw in relation to the upper and lower surfaces of the metal and gives a very easily interpreted display. Whenever it is desired to ascertain the extent of a flaw and wherever scanning procedure allows, it is recommended that the plan view data be recorded while the B-scan or cross-section is being observed on the television tube.

SUPERSONIC MEASUREMENT

W.S. Erwin

Steel Magazine
pp 181-188

March 5, 1945

Use of U/S apparatus in performing vital inspection of aircraft parts.

A NEW SEARCH TECHNIQUE FOR ULTRASONIC INSPECTION OF SHEET STEEL

S.D. Hart, L.C. Cardinal

Report of NRL Progress
pp 4-10

March 1964

Discussion of an U/S device with rotating transducers which has been designed and constructed to detect artificial flaws as small as 0.005 inch deep and 0.25 inch long in a steel plate.

IMMERSED ULTRASONIC TESTING AND RECORDING

W.C. Hitt, R.D. McKown

SAE paper 483A
Automotive Engineering Congress

January 8-12, 1962

AN EVALUATION OF AN ULTRASONIC INSPECTION SYSTEM EMPLOYING TELEVISION TECHNIQUES

J.E. Jacobs et. al.

Materials Evaluation
pp 209-212

May 1964

An ultrasonic imaging system was described which differed from standard systems in that an electron multiplier was added in the camera tube. The image system was found to be equal or better than a mechanically scanned through transmission system at detecting flaws. It was concluded that the system would be useful for detecting disbands, voids, and inhomogeneity with greater resolving power.

NEW ULTRASONIC METHOD FOR INSPECTING THIN SHEET

Light Metal Age
p 16

February 1964

A description was made of a new detection device called the Variable Angle Wheel (developed by Sperry). The unit is capable of generating lamb waves of various angles, and consists of one or more transducers located in the axis of a wheel filled with water. The method has the advantage of requiring minimum couplant conditions, high testing speeds, keeping variations in back angle reflections to a minimum, and elimination of tanks.

SPOT WELD SCANNER AND RECORDER SYSTEM - also - U/S BUTT WELD SCANNING/RECORDING SYSTEM (BULLETIN) -2 ea.-

Marshall Space Flight Center

(no date)

Bulletins from Technology Status and Trends Symposium.

ULTRASOUND MAPS FLAWS IN BONDS

W.N. Redstreake

Iron Age
pp 58-59

January 23, 1964

An automatic U/S test system provides detailed maps of the unbonded flaws in uranium-filled fuel elements. When a defect moves past the sensors, visual and audible alarms are triggered.

CONFERENCE ON 'NEW ELECTRONIC TECHNIQUES IN NONDESTRUCTIVE TESTING'

J.A. Sargrove

Journ. Brit. IRE
pp 256-258

April 1962

Introductory address concerning past and present developments in the field of automatic inspection and nondestructive testing.

SCANNING SYSTEMS

P. Underhill

American Rocket Soc. ARS No. 2304-62
Solid Propellant Rocket Conf.

January 24-26, 1962

Paper discussing automatic scanning systems used to locate the size, shape and location of flaws within solid propellant motors.

AN AUTOMATIC ULTRASONIC TESTING INSTALLATION FOR VERY LARGE METAL PLATES

Ultrasonoscope Co. .

Technical Communication No. 393

1962

PRESENT TRENDS IN U/S TESTING

H.E. Van Valkenberg

NDT
pp 178-180 Vol. 21 No. 3

May-June 1963

Discussion of the status of automation as applied to U/S inspection.

IMPROVED METHODS FOR MEASURING U/S VELOCITY

G.W. Willard

J. Acoustical Soc. America
pp 83-93 Vol. 23 No. 7

January 1951

Discussion of improved sound wave interference methods for measuring longitudinal and transverse U/S velocity in opaque and transparent solids by use of the U/S light diffraction system.

23. SPECIFIC METHODS (LONGITUDINAL WAVES)

ULTRASONIC APPARATUS FOR THE NDT OF STRUCTURAL BONDS

J.S. Arnold

U.S. Patent No. 2,851,876

16 Sept 1958

STRUCTURAL BOND EVALUATION

J.S. Arnold et. al.

U.S. Patent No. 3,016,735

January 16, 1962

ULTRASONICS SPECTRUM ANALYZERS

ARB No. 10851

Armed Services Technical Information Agency

July 1962

A report bibliography.

SONIC PULSE-ECHO INSTRUMENT DESIGNED FOR EXTREME RESOLUTION (SPIDER)
FOR NONDESTRUCTIVE TESTING

R.J. Botsco

NAA/LAD

PDL Report No. CD-3803

August 1964

Report presenting the basic theory and operational characteristics
of a sonic pulse-echo instrument designed for extreme resolution
(SPIDER).

METHOD OF ND ANALYSIS FOR LATENT DEFECTS

T. De Forest

U.S. Patent Office
Patent No. 3,034,334

May 1962

FREQUENCY ANALYSIS OF NOISE

E.F. Feldman

Electro-Technology
pp 36-41

June 1964

Discussion of the frequency-analysis technique peculiar to the three fundamental types of wave forms encountered in measurement and analysis of noise.

GEOMETRY OF HIDDEN DEFECTS DETERMINED BY U/S PULSE ANALYSIS AND SPECTROSCOPY

O.I.R. Gericke

Watertown Arsenal Lab. (Mass)
WAL TR 830.5/5

December 1962

A novel ultrasonic test method is described utilizing ultrasonic signals which contain a broad band of frequencies, and, in analogy to optics, can therefore be considered as "white" ultrasonic pulses. The form and spectral energy distribution, or "color", of such ultrasonic pulses is influenced by the geometry of a defect from which they are reflected. Hence, an analysis of the defect echo yields information on the defect configuration.

ULTRASONIC SPECTROSCOPY OF STEEL

O.R. Gericke

Materials Research and Standards
pp 23-30

January 1965

Discussion of methods and results of measuring the frequency components of the echo obtained in U/S testing, and application to U/S testing of steel.

DETERMINATION OF THE GEOMETRY OF HIDDEN DEFECTS BY ULTRASONIC PULSE ANALYSIS TESTING

O.R. Gericke

Journal of the Acoustical Society of America
pp 364-368 Vol. 35 No. 3

March 1963

Experimentation was described to determine the effectiveness of wide band pulses ("white pulses") rich in Fourier components. These pulses were compared to narrow band or "monochromatic" pulses on various defects. The white pulse method was considerably more effective than the monochromatic method. It was concluded that the main advantage of this method was that differences in configuration or orientation of concealed defects can be determined.

This article presents an excellent and easy to understand discussion of pulse-spectrum analysis testing which appears to be easily applicable to honeycomb panels.

DUAL-FREQUENCY ULTRASONIC PULSE-ECHO TESTING

O.R. Gericke

Journal of the Acoustical Society of America
pp 313-322 Vol. 36 No. 2

February 1964

A method was described along with reports of subsequent test whereby simultaneous testing at two different frequencies using one transducer was possible. The key to the method was electronic response curve equalization somewhat by amplification at various frequencies. It was found that this was not suited for near-surface defect-size determination, that coupling conditions exhibit frequency dependence, but that the method offered various advantages over conventional one-frequency testing. It was concluded that the method is a promising one for testing purposes but is ideally suited for other specialized purposes. It was suggested that multiple frequency work might yield better results.

This article contained some new and useful ideas for consideration with regard to NDT.
Cat: 23

SPECTRUM AND CONTOUR ANALYSIS OF ULTRASONIC PULSES FOR IMPROVED
NONDESTRUCTIVE TESTING

O.R. Gericke

Report No. WAL TR 830.5/1,
Watertown Arsenal Laboratories, Watertown, Mass.

December 1960

A novel technique for obtaining the ultrasonic attenuation frequency relationship in a single operation is suggested and investigated. This new method employs ultrasonic pulses which contain energy over a wide band of frequencies, and uses a spectrum analyzer to detect the frequency dependence of ultrasonic attenuation.

FINAL REPORT ON DEVELOPMENT OF HIGH-FREQUENCY ULTRASONIC SPECTRUM
ANALYZER

F.G. Haneman et. al.

RADC-TDR-62-343
Airborne Instruments Laboratory
Long Island, N.Y.

June 1962

A spectrum analyzer was developed that provides a frequency resolution varying from 20 to 60 kc over the 10 to 16 Mc operating range. The analyzer used ultrasonic and optical techniques to accomplish the separation and display of the signal frequencies to be analyzed. The electrical energy was converted to sonic energy in a water medium by a quartz transducer. This energy was diffracted by an echelon reflecting diffraction grating and then focused by a focusing reflector. The display was obtained using a schlieren readout system. Collimated light is transmitted through the region containing the focused sonic energy that is distributed.

IMMERSION RESONANCE TESTING

R.V. Harris

U/S News
pp 6-11

Spring 1962

Techniques and basic theory of immersion resonance testing as applied to various materials.

RESONANCE TESTING WITHOUT CONTACT

R.V. Harris

U/S News
pp 10-15

Winter 1960

Use and application of the Vidigage in U/S pulse echo flaw detection.

FREQUENCY DEPENDENT EFFECTS IN U/S RESONANCE TESTING

R.V. Harris, J.E. Bobbin

NDT Journal
pp 327-332

September-October 1960

Thickness measuring w/ Vidigage.

ULTRASONIC MECHANICAL IMPEDANCE MEASURING DEVICE

E.A. Henry

U.S. Patent No. 3,057,188

9 Oct 1962

SPECTRUM ANALYSIS

Application Note 63
Hewlett-Packard Company

July 1964

Theory and application of spectrum analysis.

DETERMINATION OF SIZE OF DEFECTS BY U/S IMPULSE ECHO METHOD

J. Krautkramer

Brit. J. Appl. Physics
pp 240-245 Vol. 10

June 1959

Much to the detriment of ultrasonic testing and all attempts at standardization, it is not yet possible to compare the results from different kinds of equipment regarding the echo of a back wall or a small defect. In order to facilitate this, the relations between echo height, distance and size of circular disk defect are brought into simple and universally applicable forms. It is shown that the first back echo of a simple plate is the most convenient reference echo. With the help of a calibrated gain control as accessory to a usual flaw detector and a graphical representation of the formulae, an equivalent circular disk defect can be attributed to the actual defect.

DETERMINATION OF FLAW GEOMETRY BY U/S PULSE CONTOUR AND SPECTRUM ANALYSIS

J.J. McGuire

Watertown Arsenal Lab. (Mass)
WAL TR 830.5/2

July 1961

This report describes the application of U/S pulses of almost a rectangular envelope to pulse-echo testing, resulting in the simultaneous transmission of a wide band of U/S frequencies.

MATERIALS TESTING WITH ULTRASONICS (KRAUTKRAMER)

L.D. Rozenberg

Soviet Physics-Acoustics
Vol. 8 No. 4

April-June 1963

Comment: critique on Krautkramer, bibliography.

FREQUENCY BANDWIDTH CONSIDERATIONS IN ULTRASONIC TESTING

C.P. Merhib

Watertown Arsenal Laboratory, Watertown, Massachusetts

WAL TR 143.7/1

January 1963

The determination of flaw geometry and flaw orientation is a complex and difficult problem whose solution has been sought since the beginning of ultrasonic testing. Significant advances have been made toward solution of this problem. but many details have yet to be resolved.

The frequency bandwidth effects in relation to the above problem and the influence of bandwidth on amplitude indications from test blocks commonly used to calibrate equipment sensitivity are discussed. In addition, an outgrowth of the above work is a realization of the necessity for periodic evaluation of transducers.

ULTRASONIC SPECTRUM ANALYZER. RESONANCE METHODS

R.M. Wilmotte

Report No. 10, Proj. 101
Raymond M. Wilmotte, Inc.
Washington, D.C.

September 1955

Sonic resonance, quarter-wave sections as impedance transformers, experimental units and measuring equipment.

ULTRASONIC SPECTRUM ANALYZER. SURVEY OF TRANSMISSION MEDIA

R.M. Wilmotte

Report No. 1005, Proj. 101
Raymond M. Wilmotte, Inc.
Washington, D.C.

A survey of transmission media including U/S properties in solids, and measurement techniques.

ULTRASONIC SPECTRUM ANALYZER. FREQUENCY PARTITIONING METHOD SURVEY

R.M. Wilmotte

Report No. 1007, Proj. 101
Raymond M. Wilmotte, Inc.
Washington, D.C.

June 1955

Frequency partitioning methods, scale expansion, and amplitude indication.

Cat: 23

24. SPECIFIC METHODS (LAMB, RALEIGH, SHEAR)THE PROPAGATION OF WAVES IN PLATES - LAMB & RAYLEIGH WAVES

F.A.Firestone & D.S.Ling, Jr.

Sperry Products, Inc.
TR 50-6001

1958

LAMB WAVES - THEIR USE IN NONDESTRUCTIVE TESTING

R.A.di Novi

ANL-6630
Argonne National Laboratory

Mar 1963

A study was made to determine the effectiveness of Lamb waves with respect to shear waves for the testing of thin plates and tubes. Simulated cracks were made by scratching the samples and tests were made with both shear and Lamb modes using pulse echo techniques; results are presented.

SOME NONDESTRUCTIVE TESTS FOR FILAMENT-WOUND STRUCTURES

J.A. Hendron et. al.

Stds. for Filament-Wound Reinforced Plastics
pp 261-271

Experimental results are given for several nondestructive tests designed to measure the resin to glass ratio, to measure thickness, and to locate voids. The measurement of back-scattered beta particle using a radioactive source show promise for monitoring the resin to glass ratio especially as an in-process control. Two methods of measuring the thickness of nonmetallic materials are discussed and the results of thickness measurements in the range from zero to 3 in. are given for an eddy current "lift-off" measurement method and for a capacitance measurement method. Both of these methods measure thickness from one side only but both require a metallic conductor on the other side. The "corona method" is described and its use for the detection of voids in resin-glass structures is discussed.

ULTRASONIC FLAW DETECTION IN PIPES BY MEANS OF SHEAR WAVES

C.D. Moriarty

Trans. of ASME

April 1951

Shear Waves were discussed as a reliable means of flaw detection in pipes. After a brief introduction in which the theory of shear waves was discussed, experimental methods are listed for generating and utilizing shear waves in pipe testing.

INSPECTION OF METALS WITH ULTRASONIC SURFACE WAVES

W.C. Minton

Nondestructive Testing
pp 1-4 Reprint 50-850

July-August 1954

A brief theoretical discussion on the production of surface waves, their propagation and attenuation when traveling in metals. A number of applications of surface wave methods to actual testing problems are discussed and illustrated in detail.

VARIABLE DELAY LINE USING U/S SURFACE WAVES

J.D. Ross

IRE National Convention Record Part 2
pp 118-120

1958

A discussion of a delay line using surface waves that can produce delays up to several milliseconds. A helical path along a cylinder provides a long path length for the surface wave. Barium titanate elements are used as both transmitting and receiving transducers.

PLATE WAVES SIMPLIFY CONTINUOUS U/S TESTS

Steel Magazine
p 79

October 23, 1961

METHOD OF APPLYING LAMB WAVES IN U/S TESTING

D.C. Worlton

U.S. Patent No: 3,165,922

January 19, 1965

APPLICATIONS OF LAMB WAVES IN ULTRASONIC TESTING

D.C. Worlton

Symposium on NDT in the Field of Nuclear Energy
4/16-18/57 ASTM Special Pub. No. 223
pp 260-265

1957

ULTRASONIC TESTING WITH LAMB WAVES

D.C. Worlton

Nondestructive Testing

July-August 1957

Lamb waves are extensively described and in particular, differentiated from longitudinal, shear, and surface waves. Several applications in nondestructive testing are mentioned, and the advantage of being able to use any pulse length for the test is emphasized. (The article provides a good introduction to Lamb wave theory.)

Cat: 24

25. ELECTRONIC EQUIPMENT**MEASUREMENT OF DELAY IN U/S SYSTEMS****D.L. Arenberg**IRE National Convention Record Part 2
pp 121-133

1958

Presents a classification and comparison of the advantages and limitations of methods used in measurement of delay time for U/S testing delay-line techniques.

PROCEDURES FOR TESTING ULTRASONIC DELAY LINESArenberg U/S Laboratory
Jamaica Plain, Mass.
Bulletin TD(58)Rev.

1959

Discussion of the use of U/S test equipment with reference to U/S delay lines, including general application in U/S testing.

ADDITION B - PULSE AMPLITUDE INHIBITORArenberg U/S Lab.
Jamaica Plain, Mass.
Bulletin TE 76(64)

1964

U/S DELAY-LINE TERMINATING CIRCUITS & PASSBAND MEASUREMENTS**M. Axelbank**IRE National Convention Record Part 2
pp 147-152

1958

Description of a single-tuned terminating circuit, that is not disturbed by series lead inductance, for use with high frequency, large capacity delay-lines. The circuit has been adapted to the problems of measuring the band-pass curve of a delay line.

APPARATUS FOR THE MICROSCOPIC INVESTIGATION OF FATIGUE STRENGTH

Balakhontsev

Zavodskaya Laboratoriya
pp 752-53 Vol 30 No. 6

1964

Description of a reliable and convenient micropulser enabling microexamination of metal specimens under tensile-compressive fatigue loads. Kinetics of apparatus (Fig. 1). Propagation of a fatigue crack in Cr-Mn-Si steel, observed after various numbers of load cycles (Fig. 2).

TIME INTERVAL MEASUREMENTS AND HOW TO MAKE THEM

Beckman Instruments, Inc.
Richmond, California
Data File 112

no date

Description of equipment and techniques for performing time interval measurements.

FREQUENCY MEASUREMENTS AND HOW TO MAKE THEM

Beckman Instruments, Inc.
Richmond, Calif.

no date

Discussion of methods and equipment for performing frequency measurements.

PRECISION U/S VELOCITY MEASUREMENTS

R.L. Forgacs

Electronics Magazine
pp 98-100 Vol. 33 No. 47

November 18, 1960

Article describes an improved sing-around system capable of detecting U/S velocity changes two orders of magnitude smaller than possible with previous sing-around systems.

BRANSON SONORAY & SONOGATE U/S FLAW DETECTION EQUIPMENT

Branson Instruments, Inc.
Stamford, Conn.

Advertisement

1960

TIME DOMAIN REFLECTOMETRY

Application Note 62
Hewlett-Packard Co.
Palo Alto, California

1964

MEASUREMENT OF PHASE SHIFT AT AUDIO FREQUENCIES USING A MAGSLIP AS A CALIBRATED REFERENCE STANDARD

A.G.J. Holt

Journal Brit. I.R.E.
pp 305-308

October 1963

A circuit is described which permitted a direct quantitative read-out of phase shift using a calibrated dial in conjunction with a magstrip. The operator would not be required to make any complicated adjustments or CRT readings using this method since all data could be taken from the calibrated dial. Preliminary tests with the apparatus yield an accuracy of plus or minus 2 degrees over a range of 300cps to 18 kc/s.

PRECISION PHASEMETER

J. Kritz

Electronics Magazine
pp 102-106

October 1950

Description of a precision phasemeter capable of phase difference measurements accurate to 0.1 degree. Method of display, circuitry, developmental problems and test methods are discussed in detail.

A. Macmullen

Instruments & Control Systems
pp 91-93

January 1965

Discussion of theory and practices relating to obtaining maximum accuracy in the performance of phase measurement.

SPURIOUS INDICATIONS IN U/S CATHODE RAY OSCILLOGRAMS

E. Marianeschi, T. Tili

Metallurgia Italiana 51
pp 319-323

1959

CHARGE AMPLIFIER APPLICATIONS

D. Pennington

Instruments & Control Systems
pp 81-87

January 1965

Detailed description of charge amplifier theory and application.

NOTES ON MICROWAVE MEASUREMENTS

Bulletin
Polarad Electronics Corp.
Long Island, N.Y.

May 1958

Detailed description of Polarad test equipment and related applications.

A STUDY OF WAVEFORMS IN THE GENERATION AND DETECTION OF SHORT U/S PULSES

M. Redwood

Applied Maths. Research
pp 76-84 Vol. 2 No. 2

April 1963

SOUNDS GREAT FOR TESTING WITH THE SONIC COMPARATOR

Saturn Electronics Co.
Grand Island N.Y.

Bulletin

no date

FACTORS TO CONSIDER IN SELECTING ULTRASONIC TESTING EQUIPMENT

R.A. Seidel

Metal Progress
pp 84-87 Vol. 80

August 1961

U/S INSPECTION EQUIPMENT PROGRAM

Sperry Products, Inc.

Progress Report No. 6
Contract No. AF 33(600)-29879

1955

Series of reports covering investigation and review of equipment
available for U/S inspection applications.

ULTRASONIC TESTING INSTRUMENT Mk. 3C

Ultrasonoscope Co.

Specification Sheet 435:0:0d

no date

ADDITIONAL TABLES FOR DESIGN OF OPTIMUM LADDER NETWORKS

L. Weinberg

J. Franklin Inst.
pp 127-138 No. 264

August 1957

AD-YU ELECTRONICS BULLETINS

Ad-Yu Electronics Inc.
Passaic, N.J.

1964-1965

Digital Phase Meter
Video and RF Phase Meter
Microwave Phase and Time Detector
Extra Low Noise Pre-Amplifier
Dual Channel Synchronous Filter
Wide Band Phase Standard

Series of bulletins containing description and specifications of
above listed eqpt.

Cat: 25

3. ACOUSTIC THEORY

31. WAVE MECHANICS

WAVE MECHANICS OF U/S TESTING

G. Beckman

Neue Hutte
pp 664-666
6. Jg Heft 10
(German)

October 1961

A TWO PARAMETER FAMILY OF LINE SOURCES

R.W. Bickmore & R.J. Spellmire

Tech. Memo. No. 595
Hughes Aircraft Co.

Oct 1956

A class of aperture distributions is examined which is well suited to the realization of an array having very low first sidelobes and a prescribed taper to the higher order sidelobes.

STRESS WAVE PROPAGATION AS APPLIED TO THE DETECTION OF FLAWS BY ULTRASONIC INSPECTION

D.G. Christie

Progress in NDT
pp 35-56 Vol. 1
Gordon & Breach, Science Pub. Inc. N.Y.

1964

SOUND RADIATION FROM A FINITE CYLINDER

P.G. Bordon, W. Gross

Journal of Math/Phys
pp 241-252 No. 27

no date

Method of calculating sound pressure at every point of the field originated by a vibrating body, as applied to a cylindrical shape.

STRESS WAVE PROPOGATION AS APPLIED TO THE DETECTION OF FLAWS BY U/S
INSPECTION

D.G. Christie

Progress in Nondestructive Testing
pp 35-56 Vol. 1

1959

The MacMillian Company, N.Y.

SURFACE WAVES AT ULTRASONIC FREQUENCIES

E.G. Cook, H.E. Valkenburg

ASIM Bulletin
Sperry reprint 50-897

May 1954

A review of theoretical and experimental aspects of ultrasonic surface wave propagation was presented. Particle displacement, velocity ratios, and energy relations were derived. Measurement of energy and velocity was described and methods of generation were discussed. Applications were presented.

INTERPRETING WAVE MECHANICS

L. deBroglie

Industrial Research
pp 17-21

October 1962

DAMPING OF RAYLEIGH WAVES IN AN ELASTIC LAYER ABOVE A HALF SPACE

N.N. Egorov

Acoustics
pp 300-302

1962

(Translation from Soviet Physics, Vol. 7, No. 3, pp 378-380,
July-September 1961)

MUTUAL COUPLING CONSIDERATIONS IN LINEAR SLOT ARRAY DESIGN

M.J. Ehrlich & J. Short

Tech Memo. No. 303
Hughes Aircraft Co.

Apr 1953

The mutual coupling between two resonant wave-guide fed slots on a finite ground plane were studied. A null bridge method of measurement was used to determine the relative field strength excited in the second wave-guide by mutual coupling between the slots when the generator was applied to the first wave guide.

PROPOGATION OF TRAVELING WAVES IN CIRCULAR CYLINDER HAVING HEXAGONAL ELASTIC SYMMETRY

N.G. Einspruch, R. Truell

J. Acoustical Soc. Amer.
pp 691-693 Vol. 31 No. 6

June 1959

Discussion of the problem of traveling waves in a right circular cylinder having hexagonal elastic symmetry. Exact expressions for the displacement produced by the compressional and torsional modes are obtained. A condition relating the frequency and wave number of the torsional wave is derived.

MEASUREMENTS OF MODE CONVERSION OF ULTRASONIC WAVES ON A SOLID-SOLID BOUNDARY

L. Filipczynski

Proceedings of Vibration Problems
Warsaw, pp 255-263 Vol. 4 No. 3

1963

Discussion of measurement system and results for measurement of U/S waves on a solid-solid boundary.

AN OPTICAL SCHLIEREN SYSTEM FOR ULTRASOUND IMAGING

C.E. Fitch

Materials Evaluation
pp 124-127

March 1964

Experimentation is described in which an optical schlieren system was set up to qualitatively view light diffraction by lamb waves. The results indicated that the schlieren system was capable of quantitative measurement of sound amplitude and direction if careful experimental control is exercised. (This may be a method of optically imaging flaws since impedance changes would change propagation characteristics.)

MECHANICAL RESONANCE DISPERSION IN METALS AT AUDIO-FREQUENCIES

E.R. Fitzgerald

Physical Review
pp 690-706 Vol. 108 No. 3

November 1, 1957

DIRECTIONAL CHARACTERISTICS AND ACOUSTIC IMPEDANCE OF AN ARTIFICIALLY-COMPENSATED VIBRATING CYLINDRICAL SOURCE

M. Frederici

Ricerca Sci.
pp 1826-1838

1957

ULTRASONICS

T.F. Hueter

Ultrasonic News
pp 11-13

May-June 1958

Analytical review of sonic vs. ultrasonic applications in the various fields.

EFFECT OF AN IMPURITY LAYER ON SURFACE WAVES

H. Kaplan

Physics Rev.
pp 1271-1276 Vol. 125 No. 4

February 1962

The effects of a homogenous impurity mass layer on the surface waves of a semi-infinite monatomic square lattice with nearest and next nearest neighbor central springs is studied. The relationship of the model to the analogous one- and three- dimensional problems is discussed.

REFLECTION AND TRANSMISSION AT THE SURFACE OF A METAL-PLATE MEDIA

B.A. Lengyel

Journal of Applied Science
pp 265-276 Vol. 22 No. 3

March 1951

An expression is found for the reflection coefficient applicable in the presence of a diffracted beam, by an extension of the Carlson-Heins theory. Tables and graphs are included for the coefficients associated with electromagnetic phenomena at the surface of a metal-plate media.

EXPERIMENTS ON cm WAVES IN ANALOGY WITH ACOUSTIC TECHNIQUES MADE IN GOTTINGEN

E. Meyer

J. Acous. Soc. America
pp 624-631 Vol. 30 No. 7

July 1958

Measuring techniques are compared regarding the success of analogies between acoustical systems and electromagnetic wave systems in the microwave frequency region, with emphasis on the use of reverberation chambers. The design and performance of absorbing structures of resonant and nonresonant directive microphones and electromagnetic devices constructed for the experiments is discussed.

GRAYPHICAL SOLUTION OF WAVE EQUATIONS

I. Osida

J. Phys. Soc. Jap.
pp 219-222 Vol. 3

1948

INTERPRETATION OF U/S ECHO AMPLITUDE

J.C.V. Rumsey

British J. Applied Physics
pp 25-29 Vol. 12 No. 1

January 1961

Presenting an equation for the determination of the size of defects idealized in the form of flat-bottomed holes, using an U/S reflection technique. Applicability of the equation vs. the method proposed by Krautkramer, is shown, as is confirmation of results.

BACK REFLECTION OF ULTRASONIC WAVE OBLIQUELY INCIDENT TO SOLID SURFACE IN WATER

S. Sasaki

Japan J. Appl. Phys. 2
p 198

1963

DIFFRACTION EFFECTS IN THE ULTRASONIC FIELD OF A PISTON SOURCE AND THEIR IMPORTANCE IN THE ACCURATE MEASUREMENT OF ATTENUATION

H. Seki, A. Granato, R. Truell

Journal of the Acoustical Soc. of America
pp 230-238 Vol. 28 No. 7

March 1958

A study is made of the U/S field produced by a circular crystal transducer and the integrated response of a quartz crystal receiver of equal dimensions. The transducer and receiver are taken to be coaxial and it is assumed that the transducer behaves as a piston source while the integrated response is proportional to the average pressure over the receiver area.

WELLENBREITUNG IN UNGEGRENZTEN RÖHREN UND IN SCHIEBENSCHLEIFEN

V.K. Tamm, O. Weis

Acustica
pp 8-17 Vol. 11

1961

It is shown that there is an analogy between wave propagation in infinitely extended discs or disc strips and wave propagation in infinite space or in plates respectively. In the case of disks the dilatational wave is replaced by an extensional plate wave; the shear wave type remains unchanged.

ACOUSTICAL MEASUREMENTS

E.G. Thurston, W.H. Peake

Handbook of Applied Instrumentation
McGraw-Hill Book Co. N.Y.
by Considine & Ross
pp 3-83 - 4-1

1964

ACOUSTIC-WAVE-THEORY INTERPRETATION OF OCEAN SURFACE AND BOTTOM REVERBERATION

W.J. Toulis

J. Acoust. Soc. Amer.
pp 656-661 Vol. 35

1963

HIGH FREQUENCY ULTRASONIC STRESS WAVES IN SOLIDS

E. Truell & C. Elbaum

Acoustics II
Handbuch Der Physik

1962

ATTENUATION OF RAYLEIGH WAVES ON CYLINDRICAL SURFACES

I.A. Viktorov

Soviet Physics - Acoustics
p 13 Vol. 7

1961

The author makes an experimental investigation of the attenuation of Rayleigh waves on cylindrical surfaces. It is established that on a concave cylindrical surface, Rayleigh waves suffer an additional attenuation, the magnitude of which is determined by the curvature of the surface.

TRANSMISSION AND REFLECTION OF RAYLEIGH WAVES BY
ROUNDED EDGES OF VARIOUS RADII

I.A. Viktorov

Soviet Physics-Acoustics

THE EFFECTS OF SURFACE DEFECTS ON PROPAGATION OF
RAYLEIGH WAVES.

I.A. Viktorov

Soviet Physics, Vol 3 p 304
(Doklady Akad. Nauk. USSR 119, 3)

1958

ATTENUATION & DISPERSION OF ELASTIC WAVES IN A CYLINDRICAL BAR

J. Zemanek Jr., I. Rudnick

J. Acoustical Soc. America
pp 1283-88 Vol. 33 No. 10

October 1961

The resonance method has been used to study the attenuation and dispersion of the first longitudinal mode of propagation and the dispersion of the first flexural mode of propagation of elastic waves in a cylindrical aluminum alloy rod. Q was found to decrease monotonically as the frequency increased.

32. WAVE INTERACTIONS IN SOLIDS

DIFFRACTION EFFECTS IN THE ULTRASONIC FIELD OF A PISTON SOURCE

R. Bass

J. Acoustical Soc. of America
pp 602-605 Vol. 30 No. 7

July 1958

Diffraction effects in the U/S field of a circular piston source are discussed with particular reference to the measurement of U/S absorption in liquids by the pulse technique at frequencies of 1 Mc/sec and above. A relationship given by Williams for the acoustic pressure is used to develop a new formula representing the apparent attenuation due to diffraction.

INFLUENCE OF SONIC FIELD INTERFERENCES ON FLAW DETECTION IN SOLID BODIES

I.F. Linhardt

Metall
(German)
pp 1085-1092 Vol. 12 No. 12

December 1958

GENERATION OF SECONDARY SIGNALS IN PROPAGATION OF U/S WAVES IN BOUNDED SOLIDS

M. Redwood

Phys. Soc. Proc.
pp 841-853 Vol. 72 No. 467

November 1958

The phase relation between secondary signals (secondary wave trains are generated as the result of partial conversion of compressional waves as the boundaries of the media, in solid bounded media) and the main compressional wave is analyzed, reference to the propagation of waves of frequencies of the order of 10 Mc/a in solid cylindrical specimens.

INTERACTION OF U/S WAVES IN SOLID MEDIA

F.R. Rollins

J. Applied Physics Letters
pp 147-148 Vol. 2 No. 8

April 15, 1963

U/S WAVE PROPAGATION AND INTERACTION IN SOLID MATERIALS

F.R. Rollins, L. Taylor

Air Force Materials Lab. Tech. Report
Part I No. ML-TDR-64-21

March 1964

The interaction of ultrasonic beams in solid media has been investigated from both the theoretical and experimental viewpoint. An error in the previously reported classical calculation has been corrected and relatively good qualitative agreement now exists between the classical and quantum mechanical calculations. Experiments are described which verify certain theoretical predictions concerning the magnitude of interaction and the conditions of resonance. Techniques have been devised for producing interaction in specimens of unusual shape. Furthermore, the feasibility of using interaction techniques in making a three-dimensional analysis of elastic anisotropy has been demonstrated.

ULTRASONIC WAVE PROPAGATION AND INTERACTION IN SOLID MATERIALS,
PART II

F.R. Rollins, Jr.

ML-TDR-64-21
Air Force Materials Laboratory
W-P AFB

April 1965

Further exploration of ultrasonic beam interactions has been conducted and a review of the state-of-the-art is given. Improvement in the measurement of absolute intensities and an independent evaluation of the third-order elastic constants has permitted a fairly accurate comparison between theoretical predictions of intensity of interaction and experimental results. A four-beam interaction is also shown to be weaker than the previously observed three-beam interaction. A discussion is also directed toward the energy partition that occurs when ultrasonic beams impinge on a liquid-solid boundary. An ultrasonic goniometer is described for partial investigation of this energy partition. Experimental results. ~~continued~~

U/S METHODS & RADIATION EFFECTS IN SOLIDS

R. Truell

J. Appl. Physics
pp 1275-1278 Vol. 30 No. 8

August 1959

The various mechanisms producing damping of U/S elastic waves in solids are reviewed. Attention is given to the changes in attenuation produced by pinning of dislocation lines. Measurements of U/S attenuation in irradiated single crystals of NaCl are presented and discussed.

33. EFFECT OF MATERIAL PROPERTIES ON WAVES

U/S ATTENUATION IN NORMAL METALS AT LOW TEMPERATURES

A.B. Bhatia, R.A. Moore

Phys. Review
pp 1075-1086 Vol. 121 No. 4

February 15, 1961

Expressions for the attenuation A_d and A_t of plane dilatational and shear sound waves are obtained by solving the Boltzman transport equation for the electron function f without assuming the existence of a relaxation time and for the collision term in this equation.

MICROWAVE ABSORPTION AND RELAXATION IN GASES

G. Birnbaum

Technical Memorandum SCPP-65-39
NAA-SC (NAA Library)

June 1965

AMPLITUDE DEPENDENT ULTRASONIC ATTENUATION IN SUPERCONDUCTING LEAD

H.E. Bommel, B.R. Tittmann

Physics Review Letter

March 1965

ULTRASOUND TECHNIQUES IN SOLID STATE PHYSICS

P.G. Bordoni et. al.

Metallurgia Italiana 51
(Italian)
pp 521-524

1959

EFFECT OF MICROSEPARATIONS IN STEEL ON THE ULTRASONIC DETECTION OF INCLUSIONS & ON THE DENSITY AFTER COLD WORKING

G.H. Boss

NDT
pp 237-241

July-August 1960

U/S ATTENUATION CHARACTERISTICS OF VARIOUS STEEL ALLOYS

C.J. Adams

NDT
pp 393-400

November-December 1961

DISLOCATION CONTRIBUTIONS TO THE MODULUS AND DAMPING IN COPPER AT MEGACYCLE FREQUENCIES

G.A. Alers, D.O. Thompson

J. of Applied Physics
pp 283-293 Vol. 32 No. 2

February 1961

The three elastic moduli of 99.999+% pure copper and their associated internal frictions have been measured at Mc frequencies between 4.2 and 250°K both before and after fast neutron bombardment. The changes produced by the irradiation were used to determine the dislocation contributions to the damping and moduli as a function of frequency and temperature. The dislocation damping showed the maximum predicted by Granato and Lucke to arise from the heavily damped bowing of dislocation loops. By calculating the resolved shear stress factors and measuring the dislocation density by etch pit counts, it was possible to determine the coefficient B which describes the viscous drag on a moving dislocation.

SOUND PROPAGATION IN NEAR-STOICHIOMETRIC Ti-Ni ALLOYS

D. Bradley

Journal of the Acoustic Society
pp 700-702 Vol. 37 No. 4

April 1965

Experimental data on sound velocity illustrates the unusual velocity-temperature relationship of near stoichiometric nickel-titanium alloys. The effect of temperature cycling, annealing, pressure, exposure temperature and time is also shown.

MAGNETIC CONTRIBUTION TO THE ULTRASONIC ATTENUATION IN ANNEALED AND DEFORMED STEEL (SAE 1020)

W.J. Bratina, U.M. Martius, D. Mills

J. App. Physics
pp 2415-2425 Vol. 31 No. 5

May 1960

The absorption of ultrasound of 3 Mc/s frequency was investigated in low carbon steel as a function of elastic strain applied in the presence of constant magnetic fields.

EFFECT OF DISLOCATIONS ON THE U/S WAVE ATTENUATION IN DEFORMED CARBON STEELS

W.J. Bratina, D. Mills

Acta Metallurgica
pp 419-422 Vol. 10

April 1962

A study of the ultrasonic attenuation component attributed to dislocations was made in Armco iron and carbon steels before and after they had been subjected to plastic deformation. An increase in damping associated apparently with the dislocation loop-solute atom (interstitial) interaction was observed at low strain amplitudes (down to 10^{-6}) at room temperature, however only in previously cold worked material.

FINITE AMPLITUDE U/S WAVES IN ALUMINUM

M.A. Breazeale, D.O. Thompson

Applied Physics Letters
pp 77-78 Vol. 3 No. 5

September 1963

METHOD FOR MEASURING SONIC DISLOCATION VELOCITIES

J.A. Carlson, J.J. Gilman

Technical Report No. 4
Brown University, Providence, R.I.

December 1962

Presentation of a new technique for applying dynamic stresses to elastic-plastic specimens. Intensity of the stress and the stress rate can be varied over a larger range than most other methods allow. The method can be adapted to studies of macroscopic plastic flow.

EXPERIMENTAL STUDY OF DIFFRACTION & WAVEGUIDE EFFECTS IN U/S
ATTENUATION MEASUREMENTS

E.F. Carome et. al.

J. Acous. Soc. America
pp 1417-1425 Vol. 33 No. 10

October 1961

An experimental study has been made of the propagation of ultrasound in liquids under both free-field and guided-wave conditions. Free-field measurements have been made from 1 to 20 Mc in low absorbing liquids, employing both circular and square sound sources. These measurements indicate that the correction for diffraction loss predicted by existing theories is applicable only so long as this loss is smaller than the true absorption. Attenuation measurements also have been made in liquids confined in various cylindrical and rectangular metallic waveguides.

BIBLIOGRAPHY AND TABULATION OF DAMPING PROPERTIES OF NON-METALLIC
MATERIALS.

S.H. Chi

Tech. Report No. WADD-TR-60-540
University of Minnesota

September 1962

This bibliography was compiled as an aid for those people interested in damping research and related fields. It contains a nearly complete list of references on the damping properties of non-metallic materials for the period from 1929 to 1959, together with an index on nomenclature, units, and test methods. Tabulations of the in-phase and out-of-phase components of Young's modulus and the shear modulus for the various materials are also shown, and graphical representations of experimental data indicate the loss factor values for different materials. Those values of the loss factor are compared to those of the representative structural metals.

Cat: 33

ULTRASONIC ATTENUATION UNIT AND ITS USE IN MEASURING ATTENUATION IN
ALKALI HALIDES

B. Chick, G. Anderson, Truell

J. Acoust. Soc. Amer.
p 186 Vol. 32

1960

An instrument for measurement of ultrasonic attenuation and velocity in the frequency range from 5-200 mc/sec is described. The unit incorporates a pulsed rf oscillator, superheterodyne receiver, exponential wave-form generator, precision time delay generator (useful in velocity measurements), CRT display circuits, and appropriate synchronization circuits. Ultrasonic attenuation measurements made in single crystals of NaCl and KCl during deformation and recovery at several temperatures are reported here.

THEORY OF THE ABSORPTION OF SOUND IN SEMICONDUCTORS

Ya. M. Chikvashvili

Soviet Physics, Solid-State
pp 264-265

1963

MEASURING PREFERRED ORIENTATION IN BALL BEARINGS

H.L. Dunegan

Research/Development
p 48

no date

LOW TEMPERATURE U/S ATTENUATION IN TIN AND ALUMINUM

P.H. Filson

Phys. Rev.
pp 1516-1519 Vol. 115 No. 6

September 15, 1959

According to theory based on an ideal metal, the ultrasonic attenuation should be proportional to the square of the frequency and to the electrical conductivity of the metal. Experiments were performed to compare theoretical experimental values of attenuation in a frequency range from 100 kc/sec to 1 Mc/sec. A long wire sample coupled to a barium titanate transducer was suspended in a chamber, which in turn was placed in a liquid helium bath. A short train of sine waves was sent through the wire and the amplitude of successive reflections was measured as a function of temperature and frequency. The electrical conductivity of the sample was also measured.

ULTRASONIC TESTING AS A METHOD OF DETERMINING VARIABLES IN PROCESSING ZIRCALOY AND HAFNIUM

E.W. Fink

Symposium on NDT in the field of Nuclear Energy

4/16-18/57

ASTM Spec. Publ.

pp 175-180 No. 223

1958

ULTRASONIC ATTENUATION IN Al_2O_3 AT ULTRAHIGH FREQUENCIES AND LOW TEMPERATURES

T.M. Fitzgerald, B. Chick, R. Truell

J. Appl. Physics

pp 2647-2648 Vol. 35 No. 9

September 1964

U/S propagation at low temperatures and high frequencies is discussed in terms of the relations given by Woodruff and Ehrenreich. Phonon relaxation times calculated from thermal conductivity measurements are used.

CAVITATION AND CHEMICAL EFFECTS IN U/S STATIONARY FIELDS

I. Gabrielli, G. Iernetti

Acustica

pp 165-174 Vol. 13

1963

DAMPING OF ULTRASOUND IN METALS, CARBON STEELS AND NICKEL

P.J. Gellings

Acustica

pp 29-32 Vol. 12

1962

An experimental apparatus and technique for measuring the damping of ultrasound in metals with a resonant reverberation method is described. Experimental results obtained on a number of carbon steels and nickel are given.

STRAIN MEASUREMENT WITH U/S WAVES

R. Gerstner

Materialpruf
pp 43-46 Vol. 6 No. 2

February 1964

U/S ATTENUATION & VELOCITY DATA ON ALUMINUM SINGLE CRYSTALS AS A
FUNCTION OF DEFORMATION AND ORIENTATION

A. Hikata et. al.

Acta Metallurgica
pp 423-429 Vol. 10

April 1962

ULTRASONIC INSPECTION & EVALUATION OF PLASTIC MATERIALS

W.C.Hitt & J.B.Ramsey

Ultrasonics, Vol 1, pp 9-13

Mar 1963

A review of testing methods is given. Pulse-echo, attenuation studies and reflector techniques are discussed; the effects of acoustic impedance and attenuation are considered.

THEORY OF U/S ABSORPTION IN METALS: COLLISION-DRAG EFFECT

T. Holstein

Phys. Rev.
pp 479-496 Vol. 113 No. 2

January 15, 1959

A basic assumption of the semiclassical treatments of ultrasonic absorption in metals is that of "collision drag." This assumption states that, in the presence of an impressed ultrasonic wave, the velocity distribution toward which the conduction electrons relax is a Fermi distribution centered, not at the origin of velocity space, but at a point, v_1 , equal to the local, impressed lattice-displacement velocity. In the present paper, the explanation of this collision-drag effect in terms of basic electron-lattice theory is investigated for the case of collisions with thermal vibrations. The effect is found to originate from those higher-order terms in the electron-lattice interaction whose matrix elements are bilinear in the amplitudes of impressed and thermal lattice displacements.

U/S ABSORPTION IN LIQUID SODIUM-POTASSIUM ALLOYS

J. Jarzynski, T.A. Litovitz

J. Chemical Phys.
pp 1290-1296 Vol. 41 No. 5

September 1964

Ultrasonic absorption measurements were made in sodium-potassium alloys at temperatures from 20° (or mp) to 150°C. The measured absorption was found to be higher than the classical absorption. In liquid sodium the bulk viscosity is attributed to structural relaxation and the ratio of bulk/shear viscosity is 3. In the alloys, in addition to structural relaxation, a second relaxation loss was observed at temperatures below 80°C. This loss was greatest for an alloy of composition near 33 at.% of K.

ATTENUATION OF ULTRASOUND BY ELECTRONS IN ALUMINUM

B.K. Jones

Philosophical Magazine
pp 218-230 Vol. 9

1964

The attenuation of transverse and longitudinal waves as a function of magnetic field strength in aluminum single crystals at liquid helium temperatures is discussed most emphasis is given to the resonant interaction between the electrons and the sound wave observed for $H//q$ when large peaks are observed in the attenuation.

INSTRUMENTATION FOR ULTRASONIC ATTENUATION STUDIES

G.N. Kamm, H.V. Bohm

The Review of Scientific Instruments
pp 957-960 Vol. 33 No. 9

September 1962

A 10-350 mc pulse echo instrumentation (capable of perhaps even higher frequencies) with circuit details for 350 mc use at liquid helium temperatures is described.

MAGNETOSTRICTIVE U/S MATERIAL TESTING METHOD

W. Kaule

Technik 16
(German)
pp 385-389

May 1961

U/S METHOD FOR EXPLORATION OF PROPERTIES AND STRUCTURE OF MINERAL LAYERS

W. Koltonski, I. Malecki

Acoustica
pp 307-314 Vol. 8

1958

The method developed by the authors is based on the same principle as hydrolocation and ultrasonic flaw detection of metals using frequencies from 50 to 300 kc/s. The attenuation and velocity of wave as well as the location of the eventual inhomogeneities of the medium is determined on the basis of the size, shape and time of passing of the direct or reflected pulse. The experimental material, collected in the salt mines and quarries proves that the conditions of ultrasonic propagation in rocks are exceedingly more complicated and subject to changes, than in metals or water, but the range and accuracy of discernment is quite sufficient for practical aims.

A STUDY OF THE ULTRASONIC FIELD IN LIQUID

B. Labory, and G. Laville

C.R. Acad. Sci. Paris
(French)
pp 1401-1403 Vol. 245

1957

ULTRASONIC VELOCITY AND ATTENUATION MEASUREMENTS FOR DETERMINING
THE PROPERTIES AND STRUCTURES OF CAST IRONS AND CAST STEELS

J.D. Lavender, A.G. Fuller

The British Foundryman
pp 34-65

February 1965

The reasons for the application of non-destructive testing techniques for the determination of the properties of iron and steel castings are discussed. The methods by which these properties may be measured are described with particular reference to the assessment of the structure of heat-treated steel castings, the form and amount of graphite in iron castings, the prediction of the tensile strength of iron castings and the assessment of the chill depth or quality of chilled iron rolls.

U/S ATTENUATION IN LEAD

A.R. Mackintosh

Proc. Royal Soc.
pp 88-104 Vol. 271

January 1, 1963

The absorption of longitudinal ultrasonic waves has been studied as a function of transverse magnetic field in pure single crystals of lead at 1-2 °K. The results were found to be generally consistent with the Fermi surface of lead suggested by Gold. In particular a detailed study of the magneto-acoustic oscillations, as a function of sample orientation and field direction, allowed the determination of some of the dimensions of the hole surface in the second Brillouin zone and revealed a number of new electronic orbits on the multiply-connected surface in the third zone. The absolute magnitude of the attenuation and its dependence on propagation direction and on magnetic field was studied and the results interpreted in terms of the general theory of ultrasonic absorption.

Cat: 33

U/S ATTENUATION**L. Mackinnon**

Contemporary Physics
pp 124-138 Vol. 4 No. 2

December 1962

Ultrasonic waves have been produced in the laboratory at frequencies up to 24 kMc/s. The mechanism of the absorption process is examined and the experimental measurement of attenuation coefficient is discussed. The types of research problem for which a study of ultrasonic attenuation may be useful are summarised. Particular attention is given to the low temperature absorption of megacycle ultrasound by electrons in metals; the magnetoacoustic effect and its usefulness in evaluating the Fermi surface are briefly described.

SCATTERING OF U/S STRESS PULSES IN POLYCRYSTALLINE SOLID**M.F. Markham**

Appl. Matls. Res.
pp 109-114 Vol.2 No. 2

April 1963

Discussion of propagation of waves in silver alloy and effect of scattering in polycrystals of silver.

FREQUENCY DEPENDENCE OF U/S WAVE ATTENUATION IN ARMCO IRON & LOW CARBON STEEL**U.M. Martius, W.J. Bratina**

J. Appl. Phys.
pp 250-251 Vol. 32 Suppl. 3

March 1961

The ultrasonic wave attenuation in Armco iron and low-carbon steel was measured vs increasing and decreasing external magnetic field strength (0-400 oe) at frequencies between 1 and 7 Mc. The magnetic component of attenuation was found to increase with frequency. The structure sensitivity of the magnetic loss mechanism was studied by changing the dislocation density.

ATTENUATION AND SCATTERING OF HIGH FREQUENCY SOUND WAVES IN METALS AND GLASSES

W.P. Mason, H.J. McSkimin

J. Acoust. Soc. Amer.
pp 464-473 Vol. 19 No. 3

May 1947

By using a pulse method, attenuation and velocity measurements have been made for aluminum and glass rods in the frequency range from 2 to 15 megacycles. The sound pulses are generated by crystals waxed to the surface of the rod. This wax joint limits the band width of the transmitted pulse and measurements are made using long pulses which approach steady state conditions. The reflected pulses show evidence of several normal modes which can be minimized by using specially shaped electrodes.

ENERGY LOSSES OF SOUND WAVES IN METALS DUE TO SCATTERING AND DIFFUSION

W.P. Mason, H.J. McSkimin

J. Appl. Physics
pp 940-946 Vol. 19

October 1948

When high frequency longitudinal and transverse sound waves are sent through a multicrystalline rod of metal, attenuation losses result because of scattering and diffusion of sound waves by the grains. When the grain size is less than one-third of the wave-length, these losses are due to Rayleigh fourth power law scattering and are proportional to the grain volume. The scattering factor depends on the anisotropy of the elastic constants. Two different factors are obtained, one for shear waves and one for longitudinal waves. These factors have been evaluated for cubic and hexagonal metals. From the measured elastic constants the only metals with a low loss are aluminum, magnesium, and tungsten. ~~THESE METALS ARE THE ONLY METALS WITH A LOW LOSS~~

EFFECT OF DISLOCATIONS ON U/S WAVE ATTENUATION IN METALS

W.P. Mason

Bell System Tech. Journal
pp 903-942

September 1955

MEASUREMENT OF ULTRASONIC WAVE VELOCITIES FOR SOLIDS IN THE FREQUENCY RANGE 100 to 500 Mc.

H.J. McSkimin

J. Acous. Soc. Amer.
pp 404-409 Vol. 34 No. 4

April 1962

Apparatus for measuring ultrasonic wave velocities and hence elastic moduli by means of phase-comparison methods at frequencies as high as 500 Mc is described. Gated harmonic generators for providing pulse-modulated rf of accurately known carrier frequency and circuits for electrical coupling to resonant quartz-crystal transducers are discussed. Application to measurements on small specimens, with illustrative data for cadmium telluride, is made.

ANALYSIS OF THE PULSE SUPERPOSITION METHOD FOR MEASURING U/S WAVE VELOCITIES AS A FUNCTION OF TEMPERATURE AND PRESSURE

H.J. McSkimin, P. Andreatch

J. Acous. Soc. Amer.
pp 609-615 Vol. 34 No. 5

May 1962

A pulse superposition method of determining ultrasonic wave velocities in materials such as single crystals is shown to be well suited to measurements for pressure and temperature variations. With this method the effect of coupling between transducer and specimen can be made negligibly small. Data are presented for longitudinal waves propagated in the X direction of quartz and for XV shear waves propagated in the Y direction of quartz.

Cat: 33

A METHOD FOR DETERMINING THE PROPAGATION CONSTANTS OF PLASTICS AT
ULTRASONIC FREQUENCIES

H.J. McSkimin

J. Acoust. Soc. Amer.
pp 429-434 Vol. 23 No. 4

July 1951

A pulse technique particularly suited to dissipative materials is described for measuring attenuation and phase shift constants of plastics, using either transverse or longitudinal waves in the frequency range of 5-50 Mc.

A thin wafer of the material under test is placed between two identical fused silica buffers; and waves generated by quartz crystals at the ends of the assembly are transmitted simultaneously through the specimen in both directions. Comparison of transmitted and reflected components by means of a special balancing circuit provides information from which the complex propagation constant can be calculated, and hence dynamic rigidities and viscosities.

ANALYSIS OF THE PULSE SUPERPOSITION METHOD FOR MEASURING ULTRASONIC
WAVE VELOCITIES AS A FUNCTION OF TEMPERATURE AND PRESSURE

H.J. McSkimin, P. Andreatch

J. Acoust. Soc. Amer.
pp 609-610 Vol. 34

May 1962

A pulse superposition method of determining U/S wave velocities in materials such as single crystals is shown to be well suited to measurements for pressure and temperature variations.

PULSE SUPERPOSITION METHOD FOR MEASURING ULTRASONIC WAVE VELOCITIES
IN SOLIDS

H.J. McSkimin

J. Acoust. Soc. Amer.
pp 12-16 Vol. 33 No. 1

January 1961

The velocity of Ultrasound was measured to within one part in 5000 for round trip delays greater than five microseconds. This was done by combining several measurements of phase delay with a theoretical analysis of the reflection phase angle. (This method may be used for determining the effects of Temperature and pressure on NDT.)

INVESTIGATION OF U/S SCATTERING IN METALS

L.G. Merkulov

Soviet Physics, Technical Physics Part I
pp 59-69

January-April 1956

USE OF U/S IN INVESTIGATING OF THE STRUCTURE OF STEELS

L.G. Merkulov

Soviet Physics - Technical Physics
2 Part 2
pp 1282-1289 Vol. 2 No. 6

May-August 1957

U/S attenuation in certain steels is investigated and data provided. The problem of practical application of results for purposes of monitoring the structure of metals is discussed. A comparison of the results of metallographic and U/S investigations was made.

ULTRASONIC ATTENUATION OF METALS

J. Mertsching

Physica Status Solidi
pp 345-351 Vol. 1 (Not in English)

1961

SOME U/S MEASUREMENTS IN NORMAL AND SUPERCONDUCTING ALUMINUM

R.W. Morse, H.V. Bohn

J. Acous. Soc. America
pp 1523-1526 Vol. 31 No. 11

November 1959

Ultrasonic attenuation measurements in an aluminum single crystal near the superconducting transition temperature are described. These include both longitudinal and shear wave attenuations at frequencies of between 11 and 58 Mc/sec and at temperatures between 1.0 and 4.2°K, as well as attenuation as a function of magnetic field in the normal state. It is found that the attenuation of shear waves at the transition temperature shows a discontinuity of about 25% of the total attenuation, this fraction being relatively independent of frequency. The longitudinal wave attenuation shows a sharp but continuous drop at the transition temperature.

EXPERIMENTS WITH A PULSED ULTRASONIC TECHNIQUE

N.D.G. Mountford, R. Calvert

J. of Inst. of Metals
pp 121-127 Vol. 88

1959-1960

Experiments show that an ultrasonic technique can be used to investigate the presence of oxides and precipitated phases in melts of aluminium alloys. Conditions and rates of precipitation and solution of these solid phases can be measured, and their concentrations in different melts can be compared. The precipitation at lower furnace temperatures of intermetallic compounds of titanium and zirconium and the entrainment with them of "oxide skins", is demonstrated to be responsible for faults in castings made from the melts. The work has resulted in the development of a modified melting technique, giving better-quality melts for casting.

ABSORPTION MEASUREMENTS OF ULTRASONIC WAVES IN PLASTIC SHEETS

Y. Nakamura

Journal of Applied Physics
pp 3288-3290 Vol. 34 No. 11

November 1963

A description of an experiment to determine the absorption of ultrasound in polystyrene and plexiglass was presented. The results were presented in graph form and a Table compared them to those of previous experimenters. (Information and techniques in this paper may aid in the selection of a suitable solid couplant.)

ACOUSTIC ATTENUATION IN A SOLID PROPELLANT

B.H. Nall

AIAA Journal
pp 76-83 Vol. 1 No. 1

January 1963

The acoustic attenuation in 1-in. dia. by 15 in. long rods cast from a doublebase propellant mixture has been measured for longitudinal excitation from 500 to 14000 cps in discrete steps by the successive use of quarterwave and halfwave resonance, and pulse techniques. The data are observed to give a reasonable fit to a Q of 5.5.

VARIATION OF AMPLITUDE - DEPENDENT INTERNAL FRICTION IN SINGLE CRYSTALS OF COPPER WITH FREQUENCY AND TEMPERATURE

A.S. Nowick

Phys. Rev.
pp 249-257 Vol. 80 No. 2

October 1950

The amplitude-dependent internal friction which originates in the motion of dislocating in single crystals of copper is studied as a function of frequency and temperature. Quantities are introduced which express the dependence of internal friction and of young's modulus on strain amplitude and it is shown that these quantities are significant measures of the properties of a crystal.

U/S ATTENUATION IN NORMAL METALS

Y. Osaka

Physical Soc. Of Japan
pp 877-901 Vol. 18 No. 6

June 1963

A general treatment of U/S attenuation of both longitudinal and transverse wave in normal metals, valid for an arbitrary mean free path, is given by means of Green's function formal. SM.

ULTRASONIC ATTENUATION AND VELOCITY IN SAE 4150 STEEL

E.P. Papadakis et. al.

WAL TR 143/37
Watertown Arsenal Laboratories

December 1961

Ultrasonic attenuation and velocity measurements have been made on SAE 4150 steel in the hot-rolled, austenitized-and-quenched, and tempered conditions to study temper embrittlement. It was found that the ultrasonic measurements did not show any correlation with the hardness or the notched-bar breaking energy of the steel. The attenuation from both elastic hysteresis and Rayleigh scattering decreased on quenching and also on tempering.

U/S ATTENUATION IN SAE 3140 & 4150 STEEL**E.P. Papadakis****J. Acous. Soc. America**
pp 1628-1639 Vol. 32 No. 12

December 1960

The attenuation of longitudinal ultrasonic waves from 5 to 95 Mc is studied by the pulse technique in blocks of S.A.E. 3140 and 4150 steel to determine the loss mechanism and to find possible methods for precision testing the microstructure of materials. It is found that scattering by the grains in the polycrystalline steel is responsible for the attenuation in tempered structure. The critical quantities are the grain diameter and the average squared fractional variation in the elastic modulus of a single grain.

GRAIN SIZE DISTRIBUTION IN METALS AND ITS INFLUENCE ON U/S ATTENUATION MEASUREMENTS**E.P. Papadakis****J. Acous. Soc. America**
pp 1616-1621 Vol. 33 No. 11

November 1961

A transformation has been derived relating the number of spheres of a certain radius R per unit volume (the "volume distribution of spheres") to the number of circles smaller than a certain radius r per unit area (the "area distribution of circles") appearing on a plane cutting through the volume. The transformation was applied to several hypothetical grain-size distributions for polycrystalline metals to find the resulting hypothetical area distribution of grain images on photomicrographs.

DIFFRACTION OF ULTRASOUND IN ELASTICALLY ANISOTROPIC NaCl AND IN SOME OTHER MATERIALS**E.P. Papadakis****J. Acoustical Soc. Amer.**
pp 490-494 Vol. 35 No. 4

April 1963

RAYLEIGH AND STOCHASTIC SCATTERING OF ULTRASONIC WAVES IN STEEL

E.P. Papadakis

J. Appl. Physics
pp 265-269 Vol. 34 No. 2

February 1963

The U/S attenuation in SAE 4150 steel has been measured from 5 to 100 Mc at various stages in its heat treatment.

ULTRASONIC ATTENUATION AND VELOCITY IN THREE TRANSFORMATION PRODUCTS IN STEEL

E.P. Papadakis

J. Appl. Physics
pp 1474-1482 Vol. 35 No. 5

May 1964

U/S ATTENUATION IN METALS

A.B. Pippard

Philosophical Mag.
pp 1104-1114 Vol. 46

1955

The attenuation of ultrasonic waves by conduction electrons is analysed in terms of the free-electron model of a metal. At such low frequencies that the electronic free path is smaller than the wavelength, the result obtained agrees with that found by other authors using simpler concepts, but this agreement breaks down when the free path becomes comparable with or larger than the wavelength. At very high frequencies the attenuation of longitudinal waves increases in proportion to the frequency without limit, while that of transverse waves tends to a constant value.

THEORY OF U/S ATTENUATION IN METALS AND MAGNETO-ACOUSTIC OSCILLATIONS

A.B. Pippard

Roy. Soc. Proc.
pp. 165-193 Ser. A Vol. 257 No. 1289

September 6, 1960

The attenuation of an ultrasonic wave by direct interaction with the conduction electrons in a metal is analyzed without making any special assumptions about the shape of the Fermi surface. The problem is reduced to a calculation of the currents set up in a stationary lattice by forces on the electrons, some real (due to electric fields) and some fictitious to describe the disturbances due to the passage of the wave.

ULTRA SCHALLMESSUNGEN IN METALLEN UIN GESCHMOLZENEU ZUSTANT UND BEIM ERSTORREN

V. K. G. Plass

Acustica
pp 240-244 Vol. 13

1963

A method is described for the determination of U/S absorption in metal melts at 15 to 50 Mc/sec and temperatures up to 400 deg. C. The acoustical behaviour of the melts during solidification is described and interpreted.

ABSORPTION OF RAYLEIGH WAVES IN A LOW LOSS MEDIA

F. Press, J. Healy

J. Apply. Physics
pp 1323-1326 Vol. 28 No. 11

November 1957

U/S experiments are described in which three absorption coefficients are measured in thin Plexiglas sheets. The theoretically derived expression satisfactorily relates the observed absorption coefficients

DERIVATION OF FREE-SPACE SCALAR GREEN'S FUNCTION
(on wave equation, et. al.)

D.H. Robey

Letters to Editor
(Publication unknown)

THE MEASUREMENT OF ULTRASONIC ATTENUATION IN SOLIDS BY THE PULSE
TECHNIQUE AND SOME RESULTS IN STEEL

R.L. Roderick, Truell, Rohn

J. App. Physics
pp 267-279 Vol. 23 No. 2

February 1952

Pulse techniques for the measurement of attenuation in solids have been extended and refined sufficiently to obtain dependable measurements over a frequency range from 5 to 50 megacycles. Understanding of the relative importance of beam spreading, geometrical boundaries, and method of coupling has been improved. Coupling by means of water buffer and direct mounting is discussed in detail.

ON THE MEASUREMENT OF ULTRASONIC ATTENUATION IN SOLIDS AND SOME
RESULTS IN STEEL

R.L. Roderick, R. Truell

WAL 143/14-14
Watertown Arsenal Lab. Report

May 1951

THE INFLUENCE OF METAL GRAIN STRUCTURE ON THE ATTENUATION OF AN U/S
WAVE

R.K. Roney

PHD Thesis, Cal. Tech.

1950

Apparatus is described for the study of the propagation of U/S acoustic waves in solid bodies and its application in metallurgy. In particular, the anisotropy of attenuation in cold worked aluminum and the effect of anneal are demonstrated.

SONIC GRAIN ORIENTATION TESTER

R.E. Rowley

NDT
pp 119-120

March-April 1960

U/S DETERMINATION OF THE SUPERCONDUCTING ENERGY GAP IN In_2Bi

G.A. Saunders, A.W. Lawson

J. App. Physics
pp 3322-3324 Vol. 35 No. 11

November 1964

EFFECTS OF ENERGY IRRADIATION ON THE PLASTIC DEFORMATION OF METALS

E. Schmid

Materialpruf.
pp 274-283 Vol. 4 No. 8

August 1962

PROPAGATION OF ULTRASOUND IN FERROMAGNETIC METALS AT LOW TEMPERATURE

G. Simon

Phys. Rev.
pp 161-167 Vol. 128 No. 1

October 1962

The theory of cyclotron resonance absorption of microwaves and of U/S waves in ordinary metals is extended to ferro-magnetic metals. Formulas for velocity and attenuation of elastic waves are derived.

U/S ATTENUATION IN CAST ALUMINUM

H. Smolen, H. Rosenthal

Modern Castings (Mag)
pp 55-60

May 1959

ULTRASONIC RELAXATION LOSS IN SiO_2 , GeO_2 , B_2O_3 AND As_2O_3 GLASS

R.E. Strakna, H.T. Savage

J. Appl. Physics
pp 1445-1450 Vol. 35 No. 5

May 1964

Measurement of the temperature dependence of the longitudinal and shear U/S attenuation from 5 to 50 Mc/Sec were made in select samples of glass. In each case a relaxation loss with a distribution of relaxation times was found.

U/S DOUBLE REFRACTION IN WORKED METALS

P.F. Sullivan, E.P. Papadakis

J. Acous. Soc. America
pp 1622-1624 Vol. 33 No. 11

November 1961

The double refraction observed while measuring the attenuation of U/S transverse waves in heat-treated 4150 steel was investigated. Calculated values of fractional velocity differences are given.

ABSORPTION OF U/S SOUND WAVES IN ALUMINUM AT HIGH TEMPERATURES

V.K. Tjaden

Acustica
(German)
pp 127-136 Vol. 11

1961

The sound-echo impulse method has been used to measure the absorption of longitudinal U/S waves in two alloys of aluminum and in a single crystal of aluminum. The measurements have been made in a frequency range from 5 to 72 Mc/sec and for temperatures varying from normal room temperature to 400 deg. C.

ABSORPTION LONGITUDINALER ULTRASCHALLWELLEN IN
ALUMINUM BEI HOHEN TEMPERATURES

K. Tjaden

Acustica, Vol 11 p 127

1961

NONDESTRUCTIVE GRAIN SIZE MEASUREMENTS WITH ULTRASONICS

D.L. Worlton

J. Soc. NDT
pp 24-26 Vol. 13 No. 6

November-December 1955

The degree to which U/S energy is absorbed in traveling thru brass is shown to be related to the wavelength associated with the U/S waves and the average grain diameter of the metal.

APPLYING ULTRASONIC VISCOMETERS TO POLYMER PROCESSES

A.M. Wotring, T.B. McAweeney

ISA Journal
pp 67-69 Vol. 7 No. 10

October 1960

The article reports on original Monsanto research done to learn in which polymer systems the U/S viscometer can be used and to develop typical viscosity curves.

STUDIES OF ELASTIC WAVE ATTENUATION IN POROUS MEDIA

M.R.J. Wyllie, et. al.

Geophysics
pp 569-589 Vol. 27 No. 5

October 1962

Experiments were performed to measure attenuation in the frequency range $f < 20,000$ cps by a resonant bar method. Alundum bars were used to test the validity of the theory. Experiments were also made with natural specimens of rock.

34. EFFECT OF WAVES ON MATERIALS

STRAIN AMPLITUDE OF Mc/sec ULTRASONIC WAVES IN SOLIDS

G.A. Alers, P.A. Fleury

Journ. Acoust. Soc. Amer.
pp 1297-1304 Vol. 36 No. 7

July 1964

Measurement of strain amplitude in solids, using standing wave and pulsed conditions, using four different methods to provide data for comparison.

ULTRASONOGRAPHY

P.J. Ernst

J. Acous. Soc. Amer.
pp 80-83 Vol. 23 No. 1

January 1956

It is shown that with or without U/S lenses or other devices for the concentration of U/S energy, by ultrasonics, images can be made on photo-sensitive emulsions.

CRYSTALLIZATION OF ALUMINUM-COPPER ALLOYS AS A RESULT OF U/S OSCILLATION

G.I. Eskin, I.N. Friedlyander

U/S EFFECTS ON SURFACE REACTIONS

J.A. Hedvall

Teknisk Tidskrift 20 maj
pp 625-626

1944

BASIC PRINCIPLES OF THE APPLICATION OF SONIC AND U/S ENERGY

E.A. Hiedemann

Chem. Eng. Progress Symposium Ser.
Ultrasonics
pp 51-56 Vol. 47 No. 1

1951

KINKING IN ZINC CRYSTALS BY U/S WAVES

B. Langenecker, M.A. Frandsen, S. Colberg

Journal of the Inst. of Metals
pp 316-317 Vol. 91

1962-1963

EFFECT OF SONIC AND ULTRASONIC RADIATION ON SAFETY FACTORS OF ROCKETS
AND MISSILES

B. Langenecker

AIAA Journal
pp 80-83 Vol. 1 No. 1

January 1963

Results obtained from studies of basic phenomena of direct U/S radiation of metals, and a discussion of the theoretical aspects involved, are presented.

CHEMICAL EFFECT OF ULTRASONICS

N. Moriguchi

Jr. Chem. Soc. Japan
(Japanese)
pp 949-967 Vol. 54

1933

EFFECT OF U/S VIBRATIONS OF DIFFUSION IN STEELS AND ALLOYS AT
ELEVATED TEMPERATURES

G.I. Pogodin - Alekseev

Metallovedenie i Obrabotka Metallov
pp 14-17 No. 6

June 1958

ACOUSTO-ELASTICITY

V.J. Raelson

Armour Research Foundation
Spring Issue, pp 26-30

1962

Discussion of the use of polarized, transverse sound waves in order to develop a stress analysis technique similar, but superior to, the technique of photo elasticity.

MEASUREMENTS OF MODULUS OF ELASTICITY AND LOSS FACTOR FOR SOLID MATERIALS

A. Schlagel

Bruel & Kjaer Technical Review
pp 1-24

January 1958

INFLUENCE OF U/S ON THE CREEP OF SILVER SPRINGS

R. Siegel

Acta Metallurgica
p 160 Vol. 10

February 1962

THE EFFECT OF U/S VIBRATIONS ON THE PRIMARY CRYSTALLIZATION OF ALUMINUM ALLOYS

V.I. Slotkin, G.I. Eskin

Izvest. Akad. Nauk SSSR: Otdel.
Tekh. Nauk. (Russian)
pp 33-36 No. 9

1957

35. EFFECT OF STRESS AND STRAIN

ACOUSTOELASTICITY

R.W. Benson, V.J. Raelson

Product Engineering

July 20, 1959

Presentation of a method whereby polarized high frequency sound waves are used to check for residual stresses.

AN U/S METHOD FOR THE DETERMINATION OF STRESS

R.W. Benson

1959 IRE Wescon Convention Record Part 6A
(Abstract only)

1959

U/S STRESS ANALYSIS

R.W. Benson

U/S News
pp 14-17

Spring 1962

EFFECT OF STATICALLY APPLIED STRESSES ON THE VELOCITY OF PROPAGATION OF ULTRASONIC WAVES

R.H. Bergman, R.A. Shahbender

J. Applied Physics
pp 1736-1738 Vol. 29 No. 12

December 1958

This paper gives the results of an experimental investigation of the changes in the velocities of U/S waves propagating transverse to the direction of applied stress in an aluminum column.

DISLOCATION CONTRIBUTION TO ULTRASONIC HARMONIC GENERATION

A.D. Brailsford

Communications
pp 2256-2257

January 1964

INVESTIGATION OF RESIDUAL STRESS IN FERROMAGNETICS USING ULTRASONICS

W.J. Bratina, D. Mills

Sperry Reprint No. 50-809
(Nondestructive Testing - 1960)

1960

A paper dealing with an attempt to evaluate quantitatively the magnitude of residual stresses in low carbon steel by employing the changes in the absorption of ultrasound.

A MONOGRAM FOR PHOTOELASTICIANS

D.M. Campbell

Experimental Mechanics
p 16a

December 1964

HIGH TEMPERATURE DYNAMIC MODULUS MEASUREMENTS BY USE OF ULTRASONICS

H.L. Dunegan

Materials Evaluation
pp 266-273

June 1964

A new technique is presented for measuring velocity of ultrasonic waves in isotropic solids at temperatures to 1600 F. A unique feature of the technique is that the specimen design allows both longitudinal and shear velocity data to be obtained with one transducer by virtue of using a mode conversion principle. A detailed description of the theory, specimen preparation, instrumentation, and experimental procedure are given, along with some experimental results of the variation of Young's modulus, shear modulus, and Poisson's ratio in hafnium, 4340, and Hastelloy "C" to temperatures of 1600 F.

RECENT ADVANCES IN STRESS MEASUREMENT BY ULTRASONICS

H.A. Elion

Elion Reports
Vol. 1 No. 2

April 1960

CALORIMETRIC MEASUREMENTS OF U/S ALLOY PRODUCED STRAINS IN SOLIDS

N.G. Enspruch, F. West

J. Acoust. Society AM.
p 1160 Vol. 32

1960

A LITERATURE SURVEY ON THE EFFECTS OF ENERGY FIELDS ON SURFACE REACTIONS

K.R. Freeman

NAA/LAD TFD-64-283

April 1964

NONDESTRUCTIVE 'TENSILE TESTING' OF CAST IRON

W.A. Felix

Metal Progress
pp 91-95

February 1963

THEORY OF MECHANICAL DAMPING DUE TO DISLOCATIONS

A. Granato, K. Lucke

J. App. Physics
pp 583-593 Vol. 27 No. 6

June 1956

A quantitative theory of damping and modulus changes due to dislocations is developed. It is found that the model used by Koehler of a pinned dislocation loop oscillating under the influence of an applied stress leads to two kind of loss, one frequency dependent and the other not. The frequency dependent loss is found to have a maximum in the high megacycle range. The second type of loss is a hysteresis loss which proves to be independent of frequency over a wide frequency range which includes the kilocycle range. This loss has a strain-amplitude dependence of the type observed in the kilocycle range. The theory provides a quantitative interpretation of this loss.

EVALUATING ALUMINUM ALLOYS BY NONDESTRUCTIVE TESTS

D. Hagemaiier, R. Kleint

Metal Progress
pp 115-118

November 1964

Article concerning mechanical properties of aluminum alloys by means of conductivity tests.

SOUND REVEALS STRESS PATTERNS

Iron Age
pp 58-59 Vol. 191 No. 5

January 31, 1963

NONDESTRUCTIVE ANALYSIS OF THE BRITTLE FRACTURE BEHAVIOR OF CERAMIC MATERIALS

J.H. Lauchner et. al.

ASD TR 61-436 Part I
W-P AFB

February 1963

A technique for calculating maximum stress in an elastic loop was developed and applied to the measurement of the strength of glass fibers from three to seven mils in diameter. The strength values were related to surface condition by surface decorations techniques. Surface flaw decoration of cleaned and polished surfaces was performed by condensation of water on the surface. Minute flaws estimated to be less than 1000 Å deep were easily revealed.

Capacitance behaviors of polycrystalline materials were studied. Residual stress effects were observed under statically loaded conditions.

CRACK GROWTH

C.E. Lautzenheiser et. al.

Paper outlining the various techniques employed and the results obtained on U/S tests performed on various vessels. Included is a brief description of the theory of how U/S waves are propagated.

THERMAL STRESSES ON THE SURFACE OF TUBE-SHEET PLATES OF 10 AND 33¹/₃%
LIGAMENT EFFICIENCY

M.M. Leven, R.L. Johnson

Experimental Mechanics
pp 356-353

December 1964

U/S DETERMINATION OF ELASTIC CONSTANTS OF METALS AT ELEVATED TEM-
PERATURES

A.P. Levitt, A.G. Martin

NDT
pp 333-336

September-October 1960

Description of the technique and test system developed for a simple, rapid and accurate U/S pulse-echo technique developed for measuring the dynamic elastic constants in metals at elevated temperatures.

METHODS OF MEASURING MECHANICAL PROPERTIES OF PLASTICS WITH HIGH
FREQUENCY ULTRASOUND

H.J. McSkimin, R.P. Chambers

Bell Telephone Labs

February 1964

Description was made of two methods, water immersion and a method involving thermal bonding between the specimen and two solid rods of quartz, whereby wave velocities and attenuation of very high frequency ultrasonic waves were measured.

The techniques used in these measurements may be useful for similar measurements in metals.

USE OF HIGH FREQUENCY ULTRASOUND FOR DETERMINING THE ELASTIC MODULI
OF SMALL SPECIMENS

H.J. McSkimin

National Electronics Conference

October 1, 1956

**A NEW INTERFEROMETRIC METHOD OF TWO DIMENSIONAL
STRESS ANALYSIS**

M. Nisida & H.Saito

Experimental Mechanics, pp 366-376

Dec 1964

A discussion of the use of interferometry in obtaining both the sum and difference of principal stress simultaneously in two-dimensional stress distribution.

**ULTRASONIC DETECTION OF CHANGES IN THE ELASTIC PROPERTIES
OF A 30-70 IRON NICKEL ALLOY UPON HEAT TREATMENT**

E.P.Papadakis & Reed

J. Applied Physics

Vol 32 No. 4 pp 682-687

Apr 1961

U/s attenuation and velocity measurements were made by the pulse-echo method on specimens after various steps in their transformation from austenite to martensite.

**ULTRASONIC TESTING OF INCONEL-X PLATE & CORRELATION
OF U/S TEST WITH METALLURGICAL AND MECHANICAL PROPERTIES**

M.G.Plautin

NAA/LAD PDL Lab. Memo No. FE 12-8-3

Dec. 1958

**STUDY OF METHODS FOR NONDESTRUCTIVE MEASUREMENT OF
RESIDUAL STRESS**

F.R.Rollins

WADC TR 59-561

Midwest Research Inst

Aug 1959

New techniques of measuring residual stress are investigated, including a study of various physical phenomena which exhibit stress dependent relationship. Ultrasonics was chosen for further investigation. A technique based on the double refraction of shear waves, for measuring the average stress through certain specimens is described and sources of error are discussed.

STUDY OF ULTRASONIC TECHNIQUES OF THE NONDESTRUCTIVE
MEASUREMENT OF RESIDUAL STRESS

F.R. Rollins & P. Waldow

WADD TR 61-42, Part III
Midwest Research Inst.

May 1963

(Final report) A theoretically predicted third beam is generated at the "point" of intersection and has been experimentally observed in samples of fused silica, polycrystalline aluminum and magnesium. A potential method of 3-dimensional stress analysis is discussed. An optical system for studying beam interaction in transparent solids is described.

NDT MEASUREMENT OF TENSILE AND COMPRESSIVE STRESSES

R.A. Shahbender

IRE Wescon Conv. Record, Part 6A

1959

Discussion of the effects of stresses on the velocity of propagation of ultrasonic waves.

NONDESTRUCTIVE MEASUREMENT OF TENSILE AND COMPRESSIVE STRESSES

R.A. Shahbender

Wescon Proceedings
pp 13-18 Vol. 3 Part No. 6

1959

The paper discusses the experimental results of an investigation to determine the effects of stresses on the velocity of propagation of ultrasonic waves. The test data indicates measurable changes in the velocities of shear waves propagating transverse to the direction of applied stress.

36. FATIGUE EFFECTS

ULTRASONIC METHODS IN THE STUDY OF FATIGUE AND DEFORMATION IN SINGLE CRYSTALS

B. Chick, et al

ASD-TDR 62-186
Brown University, R.I.

Apr 1963

Report on the use of u/s methods (and some electrical conductivity measurements) for studying defect formation and motion in connection with deformation and stress cycling experiments in Al and NaCl single crystals.

THE DEVELOPMENT AND EVALUATION OF AN ULTRASONIC FATIGUE UNIT

T.E. Clifton, et al

College of Aeronautics, Note 141
Cranfield, England

Mar 1963

A fatigue test apparatus operating at 20 Kc/s is described. The unit is based on a standard magnetostriictive drive system as used in high energy stress wave generators. Some typical results on tests on Al alloys are presented.

ULTRASONICS PROVES ITS WORTH IN DETECTING FATIGUE POINTS IN ROLLER BEARINGS

I. Koved & R.T. Rospond

SAE Journal, pp 74-78

June 1965

U/s techniques are used in locating potential fatigue nuclei in roller bearings, differentiating between poor, average and good quality bearing steel in terms of group life performance.

PREDICTING FATIGUE FAILURE WITH ULTRASONICS

Metal Progress Magazine

Vol 84 No. 5

Nov 1963

ULTRASONIC CONTROL OF FATIGUE DAMAGE TO MATERIALS

P.V.Ponomarev

Zavodchaia Industrial Laboratory
Vol 28 No. 11 pp 1429-31

July 1963

A discussion of the relationship between the accumulation of fatigue damages in a material and absorption of ultrasound during the process of fatigue inspection.

PREDICTION OF FATIGUE FAILURE USING ULTRASONIC SURFACE WAVES

J.G.Rasmussen

Krautkramer Ultrasonics, Inc.
Reprint No. 901

1962

A description to the solution of the problem of predicting fatigue damage in early stages of the fatigue life of a structural part in service is presented. The method, equipment and results obtained using different surface treatments are given.

ULTRASONIC DETECTION OF FATIGUE CRACKS DURING REPEATED STATIC TESTS

Y.A.Rublev & F.S.Danilov

Zavodskaya Laboratoriya
Vol 29 No. 10 pp 1188-1191
(English translation)

Oct 1963

THE USE OF ULTRASONICS IN FATIGUE TESTING

R.B.Socky

Materials Evaluation
Vol 22 No. 11 pp 509-515

Nov 1964

USES OF ULTRASONIC METHODS TO DETERMINE FATIGUE
EFFECTS IN METALS

R. Truell, et al

WADC-TR 59-389
Brown University, R.I.

Nov 1959

This report discusses observed changes in u/s attenuation and velocity in commercially pure 1100 Al when subjected to slow continued stress cycling and a delayed recovery phenomenon that appears when cycling is interrupted.

ULTRASONIC METHODS FOR THE STUDY OF STRESS CYCLING
EFFECT IN METALS

R. Truell, et al

WADD TR 60-920
Brown University, R.I.

Apr 1961

The measurement of changes of u/s attenuation and velocity during stress cycling are shown together with accompanying changes in the metallographic character of the surface sample as determined by acetate replicas and optical methods as well as oxide replicas and electron micrographs. Equipment developed for the automatic recording of attenuation and velocity changes is also discussed.

Cat: 36

37. AMPLIF. AND RESONANCE EFFECTS .

APPLICATIONS OF ULTRASONIC PULSE INTERFERENCE

S. Aveyard & R.S.Sharpe

Detection of disbonds by the change in interface damping characteristics when using standing wave interference techniques; use of interferometer discussed.

EXCITATION OF HYPERSONIC WAVES BY FERROMAGNETIC RESONANCE

H. Bommel & K. Dransfeld

Physical Review Letters
Vol 3 No. 2 pp 83-84

July 1959

ULTRASONICS AS A TOOL FOR THE STUDY OF SUPERCONDUCTIVITY

H.E.Bommel

Bell Telephone Laboratories

1957

Paper presented at Proc. Low Temperature Conference
at Madison, Wisconsin.

ERKENNTNISSE UN FOLGERUNGEN AUS DER MESSUNG VON
GERAUSCHEN BEI ZUGBEANSPRUCHUNG VON METALLISCHEN WERKSTOFFEN

J. Kaiser

Archiv fur das Eisenhüttenwesen
pp 1-3

Jan-Feb 1953

SCIENCE CENTER HIGHLIGHTS

NAA/SC

25 June 1965

- Phonon damping
- Standing waves ... in f.c.c. crystals
- electrochemical kinetics
- Magnetic structure, Au-Fe alloy system
- Mechanical properties of solids

PRESSURE DISTRIBUTION IN THE ACOUSTICAL FIELD EXCITED
BY A VIBRATING PLATE

J. Pachner

J. Acous Soc America
Vol 21 No. 4 pp 617-625

Nov 1949

Pressure distribution in the acoustical field excited by a vibrating circular plate clamped at the edge in an infinite wall is calculated for the points the distance of which from the center of the plate is greater than 10-20 times its radius.

STIMULATION OF NUCLEAR MAGNETIC RESONANCE BY ULTRASOUND

V.A.Shutilov

Soviet Physics - Acoustics
Vol 8 No. 4 pp 303-319

Apr-June 1963

Cat: 37

4. NDT METHODS OF BOND INSPECTION

41. ADHESIVE BONDS

EVALUATION OF THE IMERSCOPE FOR THE NONDESTRUCTIVE
EVALUATION OF METAL HONEYCOMB SANDWICH PARTS

R. Anderson

NAA/LAD Report No. CD-3526

Aug 1965

DEVELOPMENT OF NONDESTRUCTIVE TESTING FOR STRUCTURAL
ADHESIVE BONDS

J.S. Arnold & C.T. Vincent

WADC TR 54-231, Part I
Stanford Research Institute

May 1954

It is found that no aspect of the low frequency behavior is indicative of joint strength. Techniques utilizing high frequency impedance measurements as provided by mechanical driving systems and steady displacements produced by the application of vacuum cups are developed. Results from these techniques justify further investigation.

DEVELOPMENT OF NONDESTRUCTIVE TESTS FOR STRUCTURAL
ADHESIVE BONDS

J.S. Arnold

WADC TR 54-231, Part 2
Stanford Research Institute

May 1955

A method of testing metal honeycomb panels was investigated utilizing a vacuum cup-optical interference system. It was found to be capable of voids in the panels but gave marginal data concerning bond strength and quality.

DEVELOPMENT OF NONDESTRUCTIVE TESTS FOR STRUCTURAL
ADHESIVE BONDS - MECHANICAL IMPEDANCE TECHNIQUE

J.S. Arnold

WADC TR 54-231, Part 3
Stanford Research Institute

Apr 1955

A FM u/s impedance sensing technique (Stubmeter) was used to measure the strength of adhesive bonds. Signal correlation curves with flatwise tensile and shear strengths was significant; disbonds were also detected. No attempt was made to detect opposite side disbonds in honeycomb sandwiches.

DEVELOPMENT OF NONDESTRUCTIVE TESTS FOR STRUCTURAL
ADHESIVE BONDS

J.S. Arnold

WADC TR 54-231, Part 4
Stanford Research Institute

Jan 1956

A 500 kc range FM u/s impedance sensing technique was used to measure adhesive bond strength and to detect disbonds. The technique showed some signal-strength correlations and readily detected "near side" disbonds in bonded honeycomb structures. Detection of opposite side disbonds was not attempted. A discussion of theoretical transducer behavior and structural loading is presented.

DEVELOPMENT OF NONDESTRUCTIVE TESTS FOR STRUCTURAL
ADHESIVE BONDS

J.S. Arnold

WADC TR 54-231, Part 5
Stanford Research Institute

Feb 1957

An u/s technique for evaluation of bonds is developed and tested. Operation of the instrument is based on the empirically observed fact that the behavior of a ferroelectric transducer, when mechanically coupled to a test specimen, is affected by the structural properties of the test specimen. Initial data provided improved means of choosing optimum frequency ranges.

DEVELOPMENT OF NONDESTRUCTIVE TESTS FOR STRUCTURAL
ADHESIVE BONDS

J.S. Arnold & C.T. Vincent

WADC TR 54-231, Part 6
Stanford Research Institute

Dec 1957

A 500 kc FM u/s impedance sensing technique was used to measure adhesive bond faults and to detect disbonds in composite structures. All faults were detected but the measurements were of marginal usefulness in several cases. An experimental technique and tests results are presented for studying the dynamic behavior of a transducer.

DEVELOPMENT OF NONDESTRUCTIVE TESTS FOR STRUCTURAL
ADHESIVE BONDS

J.S. Arnold

WADC TR 54-231, Part 7
Stanford Research Institute

Apr 1959

Laboratory work with the mechanical loading of the transducer has led to a better understanding of the relationship between bond quality and the indications thereof that are provided by u/s instrumentation. As a result, it has been possible to construct simplified apparatus...for production testing.

EVALUATION OF ULTRASONIC TEST DEVICES FOR INSPECTION OF
ADHESIVE BONDS

V.H. Boruff

ER 10911-10 (Quarterly Progress Report 10)
Martin Marietta Co.

Jan 1962

EVALUATION OF ULTRASONIC TEST DEVICES FOR INSPECTION OF
ADHESIVE BONDS

V.H. Boruff

ER 10911-11 (Quarterly Prog. Report 11)
Martin Marietta Co.

Apr 1962

Note: See REESE for earlier reports.

DEVELOPMENT OF A NONDESTRUCTIVE TEST METHOD FOR THE
QUALITY ASSURANCE OF A GLASS FILAMENT POLYURETHANE
COMPOSITE STRUCTURE.

R.J. Botsco

NAA/LAD Report No. 64EQ-378

Oct 1964

INTEGRATION OF FLAW DETECTORS IN FILAMENT WOUND AEROSPACE
STRUCTURES

R.A. Burkley & T.J. Roller

NASA Report X63-13913

APPLIED RESEARCH PROGRAM FOR DEVELOPMENT OF MEANS OF
INSPECTION OF FIBERGLASS ROCKET CASE MOTORS

J.B. Card & J.T. Collins

Final Report No. 1100
Automation Industries, Boulder, Colo.

Mar 1963

Report describes the application and limitation of commercially available u/s NDT equipment for nondestructive evaluation of the quality of fiberglass cased solid propellant rocket motors. Included is a description of the development of a low frequency u/s inspection system and special transducer assemblies for use in inspection of subject item.

STUDY OF THE STUB METER FOR USE AS A NDT DEVICE FOR
METAL SANDWICH ADHESIVE BONDS

G. Cizek

NAA/LAD PDL Report No. CD-3343

Oct 1955

AN ULTRASONIC TECHNIQUE FOR THE EVALUATION OF BONDED
HONEYCOMB STRUCTURAL MATERIAL

W.N. Clotfelter

MTF-P&VE-M-63-12
NASA report

Sept 1963

Progress to date is reported on development of a continuous wave through-transmission u/s technique that is applicable to quality verification of composite honeycomb materials.

MEANS FOR TESTING BOND STRENGTH

R. C. Crooks

U.S. Patent No. 3,014,364

December 26, 1961

THE MEASUREMENT OF DYNAMIC MODULUS IN ADHESIVE JOINTS AT U/S
FREQUENCIES

A.G.H. Dietz et. al.

ASTM
pp 1414-1426

1950

BONDING INSPECTION

Commerce Dept. (FAA)

QC Digest No. 5
Bureau of Flight Standards

July 1960

ULTRASONIC INSPECTION METHOD

M. E. Cram et al

U.S. Patent No. 3,115,770

December 31, 1963

NONDESTRUCTIVE TESTING OF ADHESIVES BY ULTRASONIC WAVES

A.G.H. Dietz

Symposium of Soc of Chemical Industries,
London, England pp 218-224

1954

ACOUSTIC SPECTROMETRY OF ADHESIVES

J.V. Fitzgerald

Adhesives Age Vol 6 No. 11, pp 36-38

Nov 1963

Newly developed electronic instrument measures the acoustic
absorption of different materials.APPLICATIONS & ADJUSTMENTS OF THE 1510 PROBE OF THE
FOKKER BOND TESTER

Fokker

Report No. R-296
Royal Netherlands A/C Factory

Aug 1961

ULTRASONIC MEASUREMENT APPARATUS

L. D. Furon

U.S. Patent No. 3,011,338

December 5, 1961

FLAW DETECTION APPARATUS

L. D. Furon

U.S. Patent No. 3,011,339

December 5, 1961

NONDESTRUCTIVE TESTING OF ADHESIVE BONDED JOINTS

H.M. Gonzalez & C.V. Cagle

Paper presented at 4th Pac. Meeting of Soc. ASTM Oct 1962
(Hughes Aircraft Co.)

NDT DEVELOPMENT FOR POLARIS FILAMENT WOUND CHAMBERS

A.M. Granat & P.S. Steinkritz

Paper, Proc. 4th Annual Symposium on NDT of
A/C and Missile Components, San Antonio, Texas 1963
pp 115-119

ADHESIVE BONDED JOINTS

E.L. Gray

American Machinist
pp 122-125

Dec 1956

ACOUSTICAL ANALYSIS OF FILAMENT WOUND POLARIS CHAMBERS

A.T. Green et al

Bi-Monthly Prog. Report No. 3
Report No. O672-01 BM-3
Aerojet General Corp.

Jan 1963

ACOUSTICAL ANALYSIS OF FILAMENT WOUND POLARIS CHAMBERS

A.T. Green, et al

Report No. O672-01F
Aerojet General Corp.

Sept 1963

Final report submitted in fulfillment of Contract NOW 62-1007c.

TESTING ADHESIVE BONDED METAL SANDWICH STRUCTURES

J. Grindrod

Sheet Metal Industries
p 444

June 1955

REPORT ON SPECIAL MEETING TO DISCUSS NDT FOR FILAMENT
WOUND FIBERGLASS MOTOR CASES

S.D. Hart

TN-221-1
Naval Research Laboratory

Jan 1963

Includes a report of D.C. Erdman on linear modulated FM pulsed wave which was capable of resolving flaws 1/4- to 3/8-in. below the surface. Also S.D. Hart's description of a test in which local heating by hi-powered ultrasound, which displayed a different acoustic impedance if imperfections existed with thermal properties other than those of the parts under test.

ULTRASONIC INSPECTION OF REINFORCED PLASTICS AND RESIN
CERAMIC COMPOSITES

C.H. Hastings, et al

J. Soc. NDT, Vol 19 No. 5 pp 340-346 Sept-Oct 1961

Several u/s explorations undertaken in the past two years are retraced; two current u/s problems are mentioned, and a general pattern of attack for the NDT of subject materials is discussed.

Note: See also report No. R-61-3, Avco Corp.

CORONA AND MICROWAVE METHODS FOR THE DETECTION OF VOIDS
IN GLASS-EPOXY STRUCTURES

J.A. Hendron, et al

Materials Evaluation pp 311-314 July 1964

THE EVALUATION OF BOND QUALITY IN HONEYCOMB PANELS USING
ULTRASONIC SURFACE WAVE TECHNIQUES

E.T. Hughes & E.B. Burstein

J. Soc. NDT Vol 17, No. 6 pp 373-377 Nov-Dec 1959

STRAIN GAGE ADHESIVE BOND DETERMINATION

Instruments-Control Sys. Magazine p 131

Jan 1965

A NONDESTRUCTIVE TEST OF GLUE BOND QUALITY

B.A. Jayne

Forest Products Journal
pp 294-301

Oct 1955

ULTRASONIC INSPECTION OF ADHESIVE BONDED ALUMINUM
SANDWICH STRUCTURES

C.C. Kammerer

ASTM STP-278 pp 47-51
Symposium on NDT in the Missile Industry

Application of Lamb wave technique to quality control inspection of bonded honeycomb structural assemblies. Describes use of the Sperry Reflectoscope and Sonafax inspection unit.

EVALUATION OF THE SPERRY REFLECTOSCOPE, LAMB WAVE ULTRASONIC
TECHNIQUE FOR NONDESTRUCTIVE INSPECTION OF ALUMINUM
SANDWICH ADHESIVE BONDS

C. Kammerer

NAA/LAD Report No. CD-3704

May 1959

NONDESTRUCTIVE QUALITY TEST OF ADHESIVE JOINTS BY MEANS
OF RESONANCE MEASUREMENTS

K. Kanamaru, et al

Kolloid-zeitschrift
Vol 170 pp 123-131

1960

ADHESIVE BONDS TESTED ULTRASONICALLY

W.B. Miller & V.H. Boruff

Adhesives Age, pp 32-35

June 1963

Described is an experiment to determine the reliability of certain portable u/s testing devices; the Folkner Bond Tester, CoindaScope and Stubmeter were found capable of discriminating between standard and substandard bonds in metal-to-metal bonds but were less effective for honeycomb sandwich panels.

EVALUATION OF ADHESION BY ULTRASONIC VIBRATIONS

S. Moses & R.K. Witt

Industrial Engrg Chemistry, Vol 41 No. 10 Oct 1949

A direct, qualitative method for measuring adhesion of organic coatings to both metal and nonmetal substrata is described, using an electrodynamic system for producing longitudinal u/s vibrations in a metal cylinder.

ACOUSTIC TECHNIQUES FOR THE NONDESTRUCTIVE EVALUATION OF ADHESIVELY BONDED COMPOSITE MATERIALS

NASA

NASA TM X-53219
Geo. C. Marshall Space Flight Center

Mar 1965

UNTERSUCHUNGEN UBER DIE ZERSTORUNGSFREIE PRUFUNG VON VERBUNDWERKSTOFFEN AUS GLASFASERN UND KUNSTHARZ MIT ULTRASCHALL

G. Niederstadt

NASA W63-14578 (DFL-192 -German)

1962

STRAIN GAUGE FOR MEASUREMENT OF STRAINS IN ADHESIVE BONDS

C.B. Norris, et al

ASTM Bulletin 218, pp 40-49

Dec 1956

A method is described for measurement of tensile strain in a thin adhesive bond between metallic adherends, by measuring the change in the electrical capacitance of the specimen.

ULTRASONIC TECHNIQUES FOR PLASTICS INSPECTION

J.B. Ramsey

British Plastics, Vol 37, No. 2 pp 63-67

1964

A survey of NDT methods that can be used on plastics. A 200 kc, CW system was used to detect disbonds through three inches of rubber. Discusses feasibility of using similar CW frequencies to obtain bonding information from the opposite side of 4-3/4 in.-thick honeycomb panels.

EVALUATION OF ULTRASONIC TEST DEVICES FOR INSPECTION OF ADHESIVE BONDS

J.P. Reese, et al

ER 10911-1 (Quarterly Prog. Report)
Martin Marietta Corp.

Oct 1959

EVALUATION OF ULTRASONIC TEST DEVICES FOR INSPECTION OF ADHESIVE BONDS

J.P. Reese, et al

ER 10911-3 (Quarterly Prog. Report 3)
Martin Marietta Co.

Mar 1960

Note: See BORUFF for reports -10 & -11.

EVALUATION OF ULTRASONIC TEST DEVICES FOR INSPECTION OF
ADHESIVE BONDS

J.P. Reese, et al

ER 10911-4 (Quarterly Prog. Report 4)
Martin Marietta Co.

July 1960

Note: See BORUFF for reports -10 & -11.

EVALUATION OF ULTRASONIC TEST DEVICES FOR INSPECTION OF
ADHESIVE BONDS

J.P. Reese, et al

ER 10911-6 (Quarterly Prog. Report 6)
Martin Marietta Co.

Dec 1960

Note: See BORUFF for reports -10 & -11.

REPORT OF INVESTIGATION ON NONDESTRUCTIVE TESTS FOR
FOAMED-IN-PLACE RESINS

I. Resnick

Proj. Report No. 1, Lab Proj. 6193
Matl. Lab., N.Y. Naval Shipyard

Sept 1961

Ultrasonic techniques were among the six methods used to test foamed-in-place resins. It was found that the resin failed to transmit the energy. 1 mc was the operating frequency and water was used as the couplant. It was believed that the individual cells acted as flaws and dissipated the energy. The method was rejected as a possible technique for NDT.

ULTRASONIC RESONANCE TESTING OF GLUED METAL JOINTS

J. Schijve

Aircraft Engineering pp 269-271

Sept 1958

Describes a method of assessing the quality of adhesive bonded structures using an u/s resonance apparatus normally used for thickness measurements.

ANALYSIS OF A PROPOSED ADHESIVE TEST

R.S. Sherrer

Materials Res. & Stds. pp 125-131

Mar 1965

Presentation of a detailed theoretical analysis of a proposed adhesive test, to determine accurate values of Young's modulus and yield stress of adhesives using a simple specimen and easily conducted test.

ULTRASONIC TESTING OF ADHESIVE BONDS USING THE FOKKER
BOND TESTER

D.F.Smith & C.V.Cagle

Paper presented at Soc. NDT, Mar 16-20-1964
(Hughes Aircraft Co.)

Procedures for fabricating test specimens and developing correlation curves are described for both over-lap type and honeycomb sandwich bonds. Data are presented showing the statistical reliability of the nondestructive predictions of bond strength.

PROCEEDINGS FOR ULTRASONIC TESTING OF ADHESIVE BONDS

O.F. Smith

Hughes Proc. Spec. HP 6-24
Hughes Aircraft Co

Nov 1964

Specification covering u/s NDT of cured adhesive bonded joints using the Fokker Bond Tester.

A NONDESTRUCTIVE TEST FOR ADHESIVE BONDED JOINTS

W. Thompson & A.T.Josling

AID Report No. N.D.T.-1712
Ministry of Aviation, Harefield, England

Jan 1964

ADHESION OF HIGH POLYMERS

R.M.Vasenin & W.C.Wake

Adhesives Age, pp 18-35

May 1965

NONDESTRUCTIVE TESTS FOR STRUCTURAL ADHESIVES

C.T. Vincent

Wescon Proceedings
Vol 01, Part 09 pp 21-30

1957

ULTRASONIC EVALUATION OF STRUCTURAL ADHESIVE BONDS

C.T. Vincent & J.S. Arnold

Nat. Electronics Conference
Proc. Vol 14 pp 951-960

1958

DEVELOPMENT OF IMPROVED ULTRASONIC BOND INSPECTION EQUIPMENT

P.E.J. Vogel & O.R. Gericke

AMRA TR 63-16
Watertown Arsenal

Oct 1963

The findings of a continuing project ... includes a description of a small immersion tank for laboratory experimentation, an evaluation of certain focused immersion transducers, and a portrayal of bond flaws detected in laminations of materials having greatly dissimilar acoustical properties.

NDT DEVELOPMENT FOR SECOND STAGE POLARIS FILAMENT WOUND
STRUCTURES

R.E. Wysznewski & F.G. Karchnak

Proc. 4th Annual Symposium on NDT of Aircraft
& Missile Components, San Antonio, Texas 1963
pp 121-137

Discussion of two methods employed by Allegheny Ballistics
Laboratory in the routine NDT of filament wound pressure
vessels; a review of existing small scale programs and plans
for future work.

42. SOLID FUEL TESTING**NDT OF SOLID PROPELLANT ROCKET MOTORS**

D.S. Dean

A discussion on the application of u/s to finding disbonds between the propellant and the heat resistant liner, and between the liner and the motor casing. Radiological means of detecting disbonds were also considered. Ultrasonic methods considered included the pulse-echo technique, Fokker bond tester, and the ultra-sound image camera.

EXPERIMENTS WITH A SOLIDPROPELLANT ACOUSTIC OSCILLATOR

J.F. Engler

AIAA Journal, Vol 2 No. 7 pp 1279-84

July 1964

Direct measurement of the unburnt length of the propellant as a function of time was made with a high frame rate motion picture camera and a Vanguard analyzer. A typical experiment is described in which acoustic oscillations in pressure, with frequencies of 1500 to 2000 cps and amplitude of 16 psi are superimposed upon a slowly oscillating mean pressure of nominal value 200 psia.

ADMITTANCE MEASUREMENTS OF SOLID PROPELLANTS BY AN ACOUSTIC OSCILLATOR TECHNIQUE

S.N. Foner, et al

AIAA Journal, Vol 2, No. 6 pp 1123-29

June 1964

An acoustic oscillator technique designed to study the acoustic response of stable propellant systems is described. The method developed uses an external source of acoustic energy to excite the oscillations and affords a direct means for measuring the margin of system stability.

DEVELOPMENT OF NDT TECHNIQUES FOR LARGE SOLID PROPELLANT
ROCKET MOTORS

C. Harris

UTC 2015-QP-1
United Tech. Center, Sunnyvale, Calif.

June 1962

First quarterly report submitted for Contract AF 04(611)-8018.

DEVELOPMENT OF NDT TECHNIQUES FOR LARGE SOLID PROPELLANT
ROCKET MOTORS

C. Harris

UTC 2015-QP-2
United Tech. Center, Sunnyvale, Calif.

Sept 1962

Second quarterly report submitted in fulfillment of
Contract AF 04(611)-8018.

DEVELOPMENT OF NDT TECHNIQUES FOR LARGE SOLID PROPELLANT
ROCKET MOTORS

C. Harris

UTC 2015-FR
United Tech. Center, Sunnyvale, Calif

Apr 1963

Final report, 1 June 1962 thru 31 Jan 1963

DEVELOPMENT OF NDT TECHNIQUES FOR LARGE SOLID PROPELLANT
ROCKET MOTORS

C. Harris

UTC 2015-MP-4
United Tech. Center, Sunnyvale, Calif

July 1962

Supplement to 17 Apr 1962 report; monthly letter report
submitted for Contract AF 04(611) 8018.

DEVELOPMENT OF NDT TECHNIQUES FOR LARGE SOLID PROPELLANT
ROCKET MOTORS

C. Harris

UTC 2015-FR Supplement
United Tech. Center, Sunnyvale, Calif

Aug 1963

Supplement to final report submitted for Contract AF 04(611)-
8018.

WHAT TO EXPECT FROM ULTRASONICS IN TESTING SOLID PROPELLANT
ROCKET MOTORS

R.E. Klient & R.D. McCown

Aircraft & Missiles, Vol 3 pp 30-33

May 1960

APPLICATION OF ULTRASONICS TO SOLID ROCKET SYSTEMS

R.E. Kleint, et al

WADD TR 60-553
Automation Industries, Danbury, Conn.

Oct 1960

Applicability of u/s inspection techniques to solid rocket
(fuel) motors is investigated. Various pulse-echo and
through-transmission techniques were utilized to determine
optimum conditions for detecting defects and displaying
them on both cathode ray image and C-scan facsimile paper
recordings.

THE NDT OF FILAMENT WOUND CONTAINERS

M.E. Liebman, et al

Proc. 4th Annual Symposium on NDT of A/C and Missile
Components, San Antonio, Texas 1963
pp 139-151

FEASIBILITY STUDY TO DETERMINE WHETHER ULTRASONIC TECHNIQUES
CAN BE USED TO MEASURE MECHANICAL PROPERTIES OF CAST POLY*
URETHANES INTENDED FOR APPLICATION AS SOLID PROPELLANT BINDERS

H.E. Van Valkenburg, et al

ASD-TDR-62-886
Sperry Products, Danbury, Conn.

July 1963

43. BRAZED BONDS

BRAZING TITANIUM SANDWICH

Aircraft & Missiles, pp 22-24

Nov 1959

EVALUATION OF PULSE ECHO ULTRASONIC INSPECTION TECHNIQUES
FOR DETERMINING THE FILET BASE WIDTH DIMENSION OF CORE
TO FACE FILLETS ON BRAZED HONEYCOMB STRUCTURES

R. Anderson

NAA/LAD Report No. CD-3743

10 Oct 1960

PRELIMINARY EVALUATION OF THE COINDA-SCOPE FOR THE NON-
DESTRUCTIVE INSPECTION OF STAINLESS STEEL BRAZED HONEYCOMB
STRUCTURES

R. Anderson

NAA/LAD Report No. CD-3738

14 Oct 1960

ULTRASONIC EVALUATION OF BRAZED HONEYCOMB STRUCTURES WITH
TAPERED FACING SHEETS

R.E. Anderson

NAA/LAD Report No. CD-3728

July 1960

PRODUCTION TESTING OF BONDED MATERIALS WITH ULTRASONICS

G.B. Baumeister

ASTM Bulletin 204, pp 50-53

Feb 1955

Data correlating the various parameters with the extent of unbonded area, and typical industrial applications of ultrasonics for the detection of lack of bond are presented.

FLUOROSCOPY PROVES FAST METHOD IN CHECKING HONEYCOMB PANELS

W.R. Bear & W.S. Diehl

Iron Age, pp 106-108

7 May 1959

DETECTION OF HONEYCOMB PANEL DISBONDS ADJACENT TO ACCESSIBLE FACING SHEET SURFACE

R.J. Botsoe

NAA/LAD Report No. CD-3795

10 Feb 1964

IN-MOTION PARAMETERS FOR APPLICATION IN THE NONDESTRUCTIVE TESTING OF BRAZED HONEYCOMB STRUCTURES

G. Boyce, et al

NAA/LAD Report No. CD-3739

June 1961

DEVELOPMENT OF ULTRASONIC TECHNIQUES FOR THE EVALUATION OF BRAZED JOINTS

K.V. Cook, et al

J. Welding Research Supplement
Vol 41, No. 9 pp 4045-89

Sept 1962

Lamb wave technique vs ringing and contact-resonant ultrasonic techniques and their application to evaluation of various types of brazed joints.

QUALITATIVE ANALYSIS OF BRAZED SANDWICH

F.J. Filippi

J. NDT pp 39-45

Jan-Feb 1959

ULTRASONICS IN BRAZE INSPECTION

P. Goddes

Aircraft/Missiles Manuf. pp 14-16

Sept 1959

Pulse echo techniques, using a focused beam, show braze integrity of thin stainless sandwich; equipment gives immediate, permanent record of tests.

INSPECTION OF BRAZED HONEYCOMB BY LOW FREQUENCY VIBRATION

D.G. Graves

NAA/LAD Report No. CD-3800

Apr 1964

SONIC ELECTROMAGNETIC INSPECTION METHOD FOR ATTACHMENT OF BRAZED HONEYCOMB

D.B. Graves

NAA/LAD Report No. CD-3801

24 Apr 1964

INVESTIGATION OF ULTRASONIC C-SCAN RECORDING OF LAP BRAZED JOINTS

D.J. Hagemaiier

NAA/Rocketdyne Lab Report No. RD 62-4

15 June 1962

Discontinuities visually apparent in fractured braze joints showed good correlation with the C-scan facsimile recording provided test parameters were established at controlled sensitivity levels.

ESTABLISHMENT OF A PROCESS SPECIFICATION FOR NDT OF
ADHESIVE BONDED JOINTS

Hughes Aircraft Co.
Report No. R-65-7

1965

Technical discussion of a proposal to conduct tests and prepare test specifications for use of the Fokker Bond Tester, using approximately 6 adhesives, both coupon shear and tensile tests, and HCP tensile tests with correlation to bond quality.

THE SURFACE TENSION METHOD OF VISUALLY INSPECTING
HONEYCOMB SANDWICH PLATES

S. Katzoff

J. NDT pp 114-118

Mar-Apr 1960

NDT EVALUATION OF VACUUM BRAZED SUPER-ALLOY AND REFRACTORY
HONEYCOMB SANDWICH PANELS

W.J. Kneval

The Martin Company, Baltimore, Md.

This paper describes the problems peculiar to the brazing technique and presents several NDT for verification of panel quality.

EVALUATION AND CORRELATION OF NDT METHODS FOR BRAZED
HONEYCOMB, Part C.

E. Lauchner & D.F.Hays

NAA/IAD PDL Report No. CD-3692-C

22 Sept 1959

Part C, Investigation of the Bondcheck BC-2 fluid repulsion paint method.

TEST MAY BROADEN HONEYCOMB USE

Steel Magazine *

Magnaflux Corp. Reprint, Bulletin BK-2

May 1960

By use of thermographic fluid, panels as large as 5 x 10 ft are inspected at a rate of 1600 sq ft an hour.

*Steel Magazine, Vol 146 pp 134-136, 23 May 1960

...A SIMPLE TEST FOR OPEN FACE HONEYCOMB

Steel Magazine, Vol 148, p-132

13 Mar 1961

TESTING CERAMIC-METAL BRAZES

J.P. Sterry

J. Metal Progress, Vol 79 No.6 pp 109-111

June 1961

44. DIFFESION BONDS

ULTRASONIC EXAMINATION OF LEAD-STEEL BONDING

E.J. Boche

Sperry Products Reprint 50-882

Jan 1958

Procedure for the use of the Sperry UR Reflectoscope for the u/s examination of lead-steel bonding.

ULTRASONIC CONTROL OF THE ADHESION OF BABBIT TO THE FACE OF SECTIONAL BUSHES AND LARGE BEARINGS

L.M. Iablonik

Zavodskaya Laboratoriya, Vol 24 pp 181-183
(English translation)

Feb 1958

Review and test of the use of the u/s deflectoscope for inspection of babbitt lined components; results indicate the method is capable of detecting disbands.

45. WELDING

WELD INSPECTOR SEES WITH SOUND

L. J. Adams

Steel

Reprint No. 50-884

December 5, 1955

Use of Sperry Reflectoscope for inspection of welded SAE 1020 tubing.

ULTRASONIC WELD INSPECTION

J. E. Bobbin

Sperry Products

Reprint No. 50-883

1959

Theory and practices concerning application of U/S techniques to weld inspection.

U/S WELD INSPECTION - A STATUS REPORT

John E. Bobbin

NDT

pp 200-202

May - June 1960

Discussion of the factors related to various proposed specifications and reference test plates.

U/S WELD INSPECTION AT WORK

John E. Bobbin

U/S News

pp 7-10

Spring 1960

Discussion of practices techniques and results in the application of ultrasonics to weld inspection.

INVESTIGATION TO DETERMINE FILLET BASE LEG DIMENSIONS FROM
INDICATIONS PRODUCED BY BONDHECK BC-3, ULTRASONIC, AND
X-RAY INSPECTION METHODS

E.A. Lauchner

NAA/LAD Lab Memo No. FE 11-9-3

Nov 1959

NEW SPRAY AND HEAT PROCESS SPOTS FLAWS IN HONEYCOMB

Magnaflux Corp.

Iron Age Reprint, Bulletin BK-1

Feb 1960

EVALUATION OF BRAZED HONEYCOMB STRUCTURES

R.C. McMaster, et al

WADD TR 60-393
Ohio State University

Sept 1960

Final report on Contract No. AF33(616)-6364, summarizing
results of a one year study of NDT methods for examination
of brazed and welded joints in complex shapes.

SUMMARY OF THE SNP SYMPOSIUM ON STAINLESS STEEL BRAZED
HONEYCOMB STRUCTURES

R.C. McMaster

J. NDT pp 263-269

Sept-Oct 1959

NEW NONDESTRUCTIVE TEST FINDS FLAWS FAST IN HONEYCOMB
SANDWICH PANELS

Metalworking Magazine, Vol 18 pp 35-36

Feb 1960

NEW NONDESTRUCTIVE TEST FINDS FLAWS FAST IN HONEYCOMB SANDWICH PANELS

Metalworking Magazine, Vol 18 pp 35-36 Feb 1960

A method of testing honeycomb panels for deformed cores, lack of braze, excessive braze, etc. consists of coating panel with a heat-affected fluid, heating the panel so the core partitions act as heat sinks, allowing panel to dry, and observing resultant patterns. Inspection of a 10 x 20 ft panel can be accomplished in approx 7 minutes.

VIDIAGE MEASUREMENT OF FACING SHEET THICKNESS ON BRAZED HONEYCOMB PANELS

J. Naughton

NAA/LAD PDL Lab Memo No. NF-2-3-1 Feb 1963

ULTRASONIC INSPECTION OF BRAZED HONEYCOMB

J. Naughton

NAA/LAD QC Specification LQ 0501-012 14 Mar 1962

PRELIMINARY INVESTIGATION TO DETERMINE FILLET BASE LEG DIMENSION FROM INDICATIONS PRODUCED BY BONDHECK BC-2, ULTRASONIC, AND X-RAY INSPECTION METHODS

W.J. Paul

NAA/LAD PDL Lab Memo No. FE 10-9-6 23 Oct 1959

CONTINUATION OF INVESTIGATION TO DETERMINE FILLET BASE LEG DIMENSION FROM INDICATIONS PRODUCED BY BONDHECK PROCESS UTILIZING THE BC-4 FLUID, AND COMPARISON WITH ULTRASONIC AND X-RAY INSPECTION METHODS

W.J. Paul

NAA/LAD PDL Lab Memo No. FE-11-9-1 Nov 1959

EVALUATION REPORT OF EUROPEAN TECHNIQUES ON NON-DESTRUCTIVE
TESTING AND WELDING MANUFACTURING PROCESSES

K. M. Boekamp

Report No. GDA63-0304
General Dynamics/Astronautics

May 1963

Description of NDT techniques and process in use in
European countries.

OPERATING MANUAL FOR THE ULTRASONIC ANALYSIS OF PLUG WELDS

R. J. Botsco

NAA/LAD PDL Report CD-3790

6 February 1964

"EELTRAZVYYKOVVOY KONTROL KAGESTRA KONTAKTNOY TOGEGNOY
Y GOVNOY SVARKY"

C. T. Hazarov and G. P. Panov

Phyzyskye Metodi Yssledovanyr
No. 10 pp 1214-1217

1958

THE INFLUENCE OF MICROSTRUCTURE ON THE U/S EXAMINATION OF
STAINLESS STEEL WELDS

E. Holmes and D. Beasley

J. Iron and Steel
pp 283-290

April 1962

The separate difficulties encountered in U. S inspection of
austenitic steel welds are defined, and where possible,
accounted for in terms of metallurgical structure.

CAT: 45

THE INFLUENCE OF MICROSTRUCTURE IN THE U/S
EXAMINATION OF STAINLESS STEEL WELDS

E. Holmes and D. Beasley

J. Iron & Steel Inst (London)
Vol 200 pp 283-90

April 1962

The difficulties encountered in U/S inspection of austenitic steel welds are defined and, where possible, accounted for in terms of the metallurgical structure.

U/S WELD TESTING IN EUROPE, & THE ATTITUDE OF
TECHNICAL CONTROL AUTHORITIES

Dr. J. Krautkramer

NDT
pp 319-324

September-October
1962

TESTING OF WELDED SEAMS IN BOILER CONSTRUCTION, ESPECIALLY
CIRCUMFERENTIAL SEAMS BELOW 4 IN. DIAMETER

H. Krautkramer

Brit. Weld. J1 V. 11 No. 12

December 1964

Description of an U/S testing & recording system used for testing welded seams.

ARE STANDARDS OR CODES PRACTICAL FOR U/S EXAMINATIONS OF METAL
AND WELDMENTS

Frank C. Parker

U/S News
pp 12-16

July-August 1958

Discussion of pressure vessel and machinery failures resulting from inadequate inspection, and preventative measures possible through application of periodic U/S inspection.

U/S WELDMENT INSPECTIONS CURRENTLY IN USE

Frank C. Parker

NDT
pp 387-393

Nov.-Dec. 1962

Purposes and advantages gained from use of ultrasonics for piping and pressure vessel inspection are enumerated; equipment accessories and typical oscillograph patterns of welding flaws are presented.

U/S EXAMINATION OF WELDMENTS & THE ESTABLISHMENT OF SAFE ACCEPTABLE LIMITS FOR DEFECTS

Frank C. Parker

NDT
pp 12-20

January 1953

A review of a variety of defects discovered by means of U/S inspection and a discussion of present and future standards for U/S inspection.

U/S INSPECTION OF WELDS ON LARGE COMPONENTS

B. M. Petrov, et al

Zavodskaya Laboratoriya
pp 1425-28 (English)

November 1960

Development of a method for establishing a list of standard defects for use as standards in U/S inspection of welds.

METHODS TO DETERMINE TEST PARAMETERS FOR ULTRASONIC INSPECTION
OF WELDS

Rocketdyne

Process Specification No. RA0115-126

July 1964

Specification containing mathematical and schematic proof
and procedures to determine test parameters for U/S
inspection of welded joints.

MANUAL ULTRASONIC INSPECTION OF FUSION WELDS

Rocketdyne

Process Specification No. RA0115-127

June 1964

Specification covering details and requirements for manual
U/S testing of complete penetration and fillet fusion welds,
for plate thickness over 3/16 inch.

U/S INSPECTION OF SUBMARINE STEEL WELDMENTS

N. A. Sinclair and M. M. Nanda

NDT
pp 58-64

Jan.-Feb. 1961

Results of a laboratory investigation to develop U/S inspection
techniques for butt weldments in ship plate are presented.
Attempts were made to establish tentative acceptance standards
which would be approx. equivalent to standards established for
radiographic inspection.

WELD INSPECTION BY ULTRASONIC WAVES

A. De Sterke

Materials Evaluation
pp 18-25

January 1964

The use of ultrasonics for examination of welds in plates over 2 inches thickness, and inspection of T-joint welds is reviewed. Equipment calibration and use of standard reference blocks is discussed.

INSPECTION OF WELDS BY MEANS OF ULTRASONICS

A. De Sterke

J. Soc NDT Vol 15 No. 5
pp 305-307

Sept.-Oct. 1957

ULTRASONIC WELD INSPECTION

The Welding Engineer (magazine)

Sperry Products Reprint No. 50-885

May 1949

Application of the Reflectoscope to weld inspection and comparison of results with radiographs.

46. PIPES AND TUBESULTRASONIC INSPECTION SPEEDS DRIVE-TUBING OUTPUT

Leo Adams

American Machinist

pp 134-136

September 12, 1955

Description of an ultrasonic inspection setup built in line with a resistance-weld tube mill.

U/S PULSE-ECHO TECHNIQUES FOR EVALUATING THICKNESS, BONDING & CORROSION

Donald Erdman

J. Soc NDT V. 18 No. 6

pp 408-410

Nov.-Dec. 1960

CONTINUOUS AND COMPLETE TESTING OF TUBES

Engineering Magazine

pp 845-846

19 June 1964

Description of a method developed to provide continuous U/S inspection of tubes together with a means for recording thickness, diameter and laminations.

ULTRASONIC INSPECTIONS OF HELICALLY WELDED PIPES

H. Fuss

Engineer's Digest

Vol 25 No. 3 pp 97-98

March 1964

Application of U/S test method, using multiple transducers, to inspection of helically welded pipes.

NONDESTRUCTIVE INSPECTION OF STEEL TUBULAR PRODUCTS

E. B. Henry

Sperry Products Company Reprint 50-810
ISA Proceedings, Pittsburg Section, 1960 Conference) 1960

Description of ultrasonic contact and water immersion inspection units used for inspection of electrical resistance welded pressure tubing.

AUTOMATIC U/S INSPECTION OF RESISTANCE WELDED TUBES

R. Gerstner

Material prof 1964
pp 320-322 Vol. 6 No. 9

TUBE TESTINGLight Metal Age (magazine)

June 1960

Description of an eddy current method used to inspect tubing.

NONDESTRUCTIVE INSPECTION OF ELECTRIC RESISTANCE WELDED PIPE

T. Manis and W. M. Smith

Sperry Products Reprint 50-812 1960
(ISA Proceedings, Pittsburg Section,
1960 Conference)

Mechanical arrangement used in U/S inspection of pipe is discussed in detail; the method is considered unique in that any movement of the pipe may be followed.

ULTRASONIC INSPECTION OF LANDING GEAR OR OTHER CYLINDRICALLY SHAPED METAL PRODUCTS

R. D. McKown

Automation Industries, Inc. Reprint 50-841

ULTRASONIC INSPECTION OF BRAZED PIPE JOINTS

M. M. Nanda, et al

Materials Evaluation
pp 315-320

July 1964

U/S inspection results of 5g brazed specimens were compared with those of visual inspection of peeled joints to determine accuracy of inspection procedures. The inspection process was accurate to approximately plus or minus 15% of true bonding of the joint.

DEVELOPMENT OF RADIOISOTOPE EXPOSURE DEVICES FOR INSPECTION OF BRAZED JOINTS IN SMALL DIAMETER TUBES

C. W. Phillips

NAA/LAD PDL Report CD-3805

June 1964

BACKING RING ELIMINATION PERMITS ULTRASONIC TESTING AND AVOIDS CRACKING AT PIPING WELDS

W. A. Pollock

Welding Journal
(Sperry Reprint 50-888)

October 1955

Description of welding technique developed to eliminate use of backing rings for pipe welds at the Oak Creek Power Plant, and the U/S test method subsequently adapted.

NONDESTRUCTIVE TESTS OF COMPONENTS OF EBR-I, CORE IV

R. H. Selner, et al

ANL-6632
Argonne National Laboratory

October 1963

Use of U/S and eddy current testing methods for reactor core components.

ULTRASONIC INSPECTION OF TUBING OR PIPE

Rocketdyne

Process Specification No. RA0115-124

April 1964

5. U/S APPLICATION TO QC

51. MISCELLANEOUS DEFECTS

ULTRASONIC TESTING OF MATERIAL FOR NUCLEAR COMPONENTS

F. W. Armstrong

J. NDT
pp 342-345

Nov.-Dec. 1957

Discussion concerning use of conventional U/S techniques for testing solid metallic materials.

THE EFFECT OF FABRICATION ON INCLUSION TYPE DEFECTS AND THEIR U/S RESPONSE

G. J. Binczewski

J. NDT Vol 18
pp 93-98

March-April 1960

Known kinds of inclusion type defects which might occur in aluminum were investigated and their specific behavior during various stages of fabrication were evaluated ultrasonically and radiographically.

USE OF ULTRASONICS FOR THE DETECTION OF SURFACE DISCONTINUITIES

J. E. Bobbin

Branson Instruments, U/S Testing Div.
Stamford, Conn.

June 1961

General discussion of the theory and technique of U/S inspection.

U/S FLAW DETECTION

D. G. Christie

British Power Engineering
Vol 3 No. 4 pp 34-39

September 1961

Principles underlying flaw detection measurements by the pulse echo technique are presented in detail.

ULTRASONIC FLAW DETECTION

Commerce Department (CAA)

Quality Control Digest No. 3
Government Printing Office

November 1958

A digest presenting basic operating theories and procedures used in U/S flaw inspection and in evaluating U/S flaw detection techniques.

PRESENT & FUTURE APPLICATIONS OF ULTRASONICS IN BIOMEDICINE

William J. Fry

Proceedings of the IRE
pp 1393-1404

May 1962

U/S METHODS FOR NEAR-SURFACE FLAW DETECTION

Otto R. Gericke

J. NDT
pp 335-338

Sept.-Oct. 1961

Note: Also appears in Applied Mech Rev. #6409
pp 5,335-338 -

9-10/61

A report of an investigation of pulse-delay techniques and the development of methods for practical applications.

U/S INSPECTION OF REFRASIL BILLETS

D.J. Hagemaler

NAA/RD IOL MPR 2-252-19

27 September 1962

THE IMPORTANCE OF ULTRASONICS IN THE INSPECTION OF THE CONVAIR
880 NAD 600 JET LINERS

A. N. Hammer

J. NDT

Nov.-Dec. 1960

(Comment: Solid metallic materials and conventional techniques)

Conventional U/S techniques are applied to the inspection of
solid metallic materials used in aircraft manufacture.

ULTRASONIC TESTING AND FLIGHT SAFETY

Harris and B. Maddox

Flight International
(English public)

7 March 1963

THE ULTRASONIC TESTING OF B.66 COMPRESSOR BLADES

Harris and B. Maddox

Aircraft Engineering
(English Public.)

October 1963

Utilization of the ultrasonoscope and Rayleigh wave mode to
detect fatigue cracks in compressor blades.

U/S DETERMINATION OF SIZE OF FLAWS

J. Krautkramer

Archiv Sur des Eisenhüttenwesen
Vol 30 pp 693-703
(German)

November 1959

ULTRASONICS IN COMMUNICATIONS & PRODUCTION

Warren P. Mason

Electronics

pp 33-39

October 18, 1963

A survey of ultrasonic techniques was presented. Included were sonar, inspection devices, delay lines, filters, high amplitude applications and transducers.

NONDESTRUCTIVE TESTING INSPECTION - PYROLYTIC GRAPHITE

L. S. McCollum

MRI 228.05

Lockheed Missiles and Space Company

June 1962

Final report describing methods used and basic concepts related to apparatus and techniques, including representative studies of some specimens.

ULTRASONIC METHOD OF TIRE INSPECTION

W. E. Morris, et al

The Review of Scientific Instruments
pp 729-734

December 1952

Principles of detecting internal defects in tires by attenuation of transmitted U/S waves is discussed. Equipment used for tire inspection is described.

THE NONDESTRUCTIVE MEASUREMENTS OF SURFACE CONNECTED DISCONTINUITIES

W. L. Shelton

NASA Report N 63 82173

A review of work in process concerning the application of the penetrant inspection process.

ULTRASONICS

Steel (magazine)
pp 80-81

September 28, 1964

A brief review of various applications of ultrasonics by different companies.

NONDESTRUCTIVE TESTING OF ROCKET COMPONENTS USING MICROWAVES
AND LOW-FREQUENCY ULTRASONICS

R. C. Stinebring and R. H. Harrison
Supervisor of NDT, Atlantic Research Corp.
Alexandria, Va.

NASA Report X64-12032
(Classified report)

Microwave treatment good, capable of determining adequate cure time, aging effects, some defects. Sonoseismic tests used through transmission, with Branson Inst. and magnetostrictive transducer; same properties checked as above, fair correlation.

ULTRASONIC FLAW DETECTION IN THE AIRCRAFT INDUSTRY

H. Tyrer and D. C. Hollamby

Ultrasonics
pp 211-219

Oct.-Dec.- 1963

Article concerning aspects of technique and standardization in U/S flaw detection.

U/S INSPECTION OF TURBINE & COMPRESSOR ROTOR BLADES FOR
CRACKS AND OTHER FLAWS

Jens Gert Rasmussen

J. NDT
pp 228-236

May-June 1958

This paper describes the use of surface wave techniques for rotor blade inspection. Basic principles for probe construction and information about the U/S equipment used is presented

52. CORROSION

MEASURING CORROSION WITH U/S GAGES

Corrosion Technology
Vol 8 pp 81-82

March 1961

Article describing use Visigauge and U/S thickness gauge.

A NEW WAY TO MEASURE U/S CAVITATION INTENSITY

Henry A. Goldsmith and R. C. Heim

Metals Engineering Quarterly
Vol 2 No. 1 pp 62-66

February 1962

A new method is described for evaluating the intensity of cavitation in an U/S processing tank. Basis of the evaluation is the ability of U/S cavitation to depolarize electrodes in galvanic or electrolytic cells.

U/S DETECTION OF INTERCRYSTALLINE CORROSION

N. V. Khimchenko and V. N. Prykhod'ho

Zavodskiya Laboratoriya Vol. 1
pp 69-71 (English)

1962

Article concerns use of shear waves to reveal the initial stages of intercrystalline corrosion in metal components, and the depth of corrosion in samples which have undergone standard tests for corrosion tendency, by means of U/S surface waves.

AN EDDY CURRENT GAUGE FOR MEASURING ALUMINUM CORROSION

S. Mori, et al

J. Corrosion
Vol 1g No. 8 pp 269t-271t

August 1963

A modified version of Doe's gauge is described, and operation and illustrative data are presented.

NONDESTRUCTIVE FLAW AND CORROSION TESTER

Process Control & Automation
Vol 6 No 5 pp 213-15

May 1959

A description of the operation and application of the Introview N/D Flaw and Corrosion tester manufactured under license and marketed by the Sperry Gyroscope Co.

DEVELOPMENT OF ULTRASONIC INSPECTION TECHNIQUES AND EQUIPMENT TO RESOLVE CORROSION CONDITIONS IN NAVY AIRCRAFT**J. B. Ramsey**

Automation Industries OM-1b-814554
(NASA facsimile No. N63 10084)

Report describing use of standard available equipment, and the results of investigations to develop U/S inspection equipment and techniques for determining corrosion condition in Navy aircraft.

NONDESTRUCTIVE TEST METHODS FOR CORROSION DETECTION**C. E. Lautzenheiser**

Materials Protection 2(1963):8, 72, 74-76

53. FORGINGS

U/S INSPECTION OF LIQUID PROPELLANT ROCKET MOTOR COMPONENTS

R. E. Kleint & C. M. Johnson

J. NDT
pp 418-421

Nov.-Dec. 1961

The need for further development of U/S standards is discussed. Illustrations of problems, and their solutions, based on consideration of sonic properties are illustrated.

U/S TESTING BY SONIC IRRADIATION AND IMPULSE ECHO METHOD

H. Krainer and E. Krainer

Arch. Eisenhüttenw Vol. 24
pp 229 - 36
(German)

May - June 1953

DETERMINATION OF DEFECT SIZE IN FORGINGS BY MEANS OF
ULTRASONICS

Paul Opel and Gunther Ivens

Archiv Fur Das Eisenhüttenwesen, Vol 33 No 5
pp 311-316
(German)

May 1962

U/S INSPECTION - TOOL FOR DETERMINING QUALITY

J. B. Morgan

Tooling and Prod. Mag.
pp 188, 193, 197

September 1965

Use of U/S inspection methods for QC of high grade steel stock.

A TECHNIQUE FOR U/S TESTING LARGE FORGINGS WITH RELATIVELY
THIN WALL SECTIONS

Gilbert E. Ronca

J. NDT
pp 191-192

May - June 1960

INFLUENCE OF GEOMETRY UPON AN U/S DEFECT SIZE DETERMINATION
IN LARGE ROTOR FORGINGS

Steven Serabian

J. NDT
pp 18-21

July - August 1956

THE TESTING IN SITU OF JET ENGINE COMPRESSOR BLADES

Ultrasonoscope Co.

Application Report
AR 90

1963

INVESTIGATIONS ON THE MEASUREMENT OF SOUND ATTENUATION AND
U/S DETERMINATION OF DEFECT SIZE

W. Knorr and H. G. Ricken

Archiv Fur das Eisenhattenwesen
Vol 33 No 5 pp 317-25
(German)

1962

54. CASTINGS AND INGOTSULTRASONIC TECHNIQUES FOR THE NONDESTRUCTIVE EXAMINATION
OF CAST ALLOYS

C. J. Abrahams and J. D. Lavender

The British Foundryman
pp 66-73

February 1965

The detection of specific casting defects is illustrated and the importance of the selection and training of operators is emphasized.

SONIC TESTING OF METAL COMPONENTS PT. I & II

E. G. Fuller

Metal Industry Vol 130 No. 7
pp 220-222

August 16, 1963

Part I: Resonant frequency measurements to evaluate the properties of castings.

Part II: Extending the use of this technique to metal sorting and flaw detection.

EVALUATION OF SURFACE DEFECTS BY NDT

W. A. Black

Blast Furnace and Steel Plant Magazine
Vol 48 pp 459-66

May 1960

CONTRIBUTION A L'ESTIMATION DE L'IMPORTANCE DES DEFAUTS DANS
LES PRODUITS SIDERURGIQUES PAR L'EXAMEN AUX ULTRA-SONS

M. Ferrero and P. Ravizza

Revue de Metallurgie
pp 445-450
(French)

May 1962

ANOMALIES IN THE U/S INSPECTION OF STEEL

W. C. Harmon

J. NDT
pp 185-188

May - June 1963

Discussion concerning reasons for caution in adopting rigid specifications and standards for the U/S inspection of steels.

THE NEED FOR CUSTOMER-SUPPLIER GROUND RULES:
U/S INSPECTED QUALITY OF 4130 & 4340 STEEL

Daniel E. O'Halloran

J. NDT
pp 28-30

Jan.-Feb. 1963

QUALITY CONTROL IN THE FOUNDRY BY ULTRASONICS

J.A.F. Jarvis

Progress in Applied Materials Research Vol. IV pp 148-171
Gordon & Breach, Science Pubs. Inc. N. Y. 1964

SOME PRACTICAL APPLICATIONS OF THE ULTRASONIC EXAMINATION OF
STEEL CASTINGS

J. D. Lavender

Journal BSCRA No. 59

April 1961

SONIC SYSTEM SPOTS STEEL INCLUSIONS

Mill & Factory (magazine)
pp 13

May 1965

USE OF NATURAL RESONANCE TO EVALUATE STRUCTURE AND STRENGTH
OF CASTINGS

Production Technology (magazine)
pp 192-194

August 1963

Article concerning the use of natural resonance to evaluate
structure and strength of castings.

NATURAL FREQUENCIES OF VIBRATION OF FIXED-FIXED SANDWICH BEAMS

M. E. Raviile, et al

J. Appl. Mechanics
Trans. ASME
pp 367-371

September 1961

The problem of the determination of the natural frequencies of
vibration of fixed-fixed sandwich beams is analyzed by an
energy approach in which the lagrangian multiplier method is
utilized to satisfy the boundary conditions of the problem.

USE OF THE BEAM DEFLECTOR TO U/S TEST BRONZE CASTINGS

John C. Smack

J. NDT
pp 85-87

March-April 1959

A test problem is described which shows a solution for immersed
U/S testing of a casting from the center hole, using a new
type transducer for close-up immersed testing in confined areas.

ARSENAL DOUBLE CHECKS X-RAY WITH ULTRASONICS

Steel (Magazine)

55. WROUGHT PRODUCTS

U/S TESTING OF TUNGSTEN AND MOLYBDENUM PRODUCTS

H. J. Booss

Metal Vol 13 No 12 (German)
pp 1128-29

December 1959

ULTRASONIC INSPECTION OF HAYNES 25 BALL BEARINGS

A. E. Brown and H. L. Dunegan

Materials Evaluation
pp 46-47

January 1965

A NEW SEARCH TECHNIQUE FOR U/S INSPECTION OF SHEET STEEL

L. C. Cardinal and S. D. Hart

NASA (Confidential) Report No: X64-12040

Mechanical impedance is defined as the complex ratio of the effective force to the resulting effective linear velocity:

$$Z_M = F/V \text{ or } Z = W F/A$$

F = Driving sinusoidal force

V = Sinusoidal velocity

W = Radial Frequency (2 f)

A = Sinusoidal acceleration

The force generator is attached to the steel motor case.

A NEWLY DEVELOPED METHOD FOR THE IMMERSED U/S TRANSMISSION TESTING OF METAL PLATES & ITS COMPARISON WITH THE FREQUENCY MODULATION METHOD

I. Egri

Acta Technica Vol 21 No 3-4
pp 327-45
(German)

1958

WIRE TESTING BY ULTRASONICS

W. Lehfeldt

Wire
pp 1131-1133

September 1960

Article describing the use of an ultrasonic technique to detect internal flaws in wire.

ULTRASONIC INSPECTION OF FERROUS AND NICKEL-BASE WROUGHT RAW STOCK

J. H. Flaherty

NAA/LAD PDL Memo FE 11-1-19

November 1961

THE IMMERSED U/S INSPECTION OF METAL PLATE

R. W. McClung

J. NDT
pp 270-275

Sept.-Oct. 1959

ULTRASONIC HARDNESS TESTING

Production Mag.
p 301

September 1965

ALL-OUT INSPECTION

Tooling and Prod. Mag.
p 176

September 1965

Brief review of QC methods used by Timken Roller Bearing Co.

ULTRASONIC INSPECTION OF WROUGHT PRODUCTS

C. Phillips

NAA/LAD QC Spec. No. LQ0501-006

May 1960

CONTINUOUS TESTING MADE POSSIBLE BY ULTRASONICS

W. A. Richards, Jr.

Wire & Wire Products
Vol. 38 pp 1525, 1599, 1601

October 1963

A review of the Lehfeldt U/S Wire Testing Unit and its application to a continuous testing process.

FLEXURAL VIBRATIONS OF ELASTIC SANDWICH PLATES

Y. Yu

J. of Aero/space Sciences
pp 272-282

April 1960

56. PROPULSION EQUIPMENTNONDESTRUCTIVE TESTING OF LARGE SOLID PROPELLANT CASE
BONDED ROCKET MOTORS

John H. Cusick

J. Soc NDT Vol. 18 No. 3
pp 195-199

May - June 1960

An analysis of the tangential radiographic method is given and U/S test methods of bond testing are discussed. Test procedures are delineated and handling apparatus illustrated.

STATIC DEFORMATION OF A PIEZOELECTRIC PLATE VIBRATING AT ITS
NATURAL FREQUENCY

B. A. Finagin

Soviet Physics - Acoustics
Vol. 8 No. 4 pp 356-359

April - June 1963

Numerical results and interference photographs are given for plates vibrating in these (subject) modes.

NEW TEST FOR GLASS FILAMENT WINDINGS

John F. Judge

Missiles and Rockets
pp 26-28

October 1962

Discussion of the use of an electrically conductive trace element wound in structure.

ULTRASONIC APPLICATIONS IN SOLID PROPELLANT MOTOR INSPECTIONS

R. D. McKown and R. R. Rowand

FEASIBILITY STUDY TO DETERMINE WHETHER ULTRASONIC TECHNIQUES
CAN BE USED TO MEASURE MECHANICAL PROPERTIES OF CAST POLYURETHANES
INTENDED FOR APPLICATION AS SOLID PROPELLANT BINDERS

A. M. Murdoch and H. E. Valkenburg

Contract AF 33&616&-7069
ASD-TDR No. N64-17116

July 1963

Experimentation was described which attempted to use ultrasonic examination to determine the physical condition of several specimens simulating both binder and propellant materials in various conditions of aging. It was found that velocity measurements of either longitudinal or shear waves was not adequate to determine structural changes due to aging, that shear wave attenuation vs. temperature measurements yield some degree of information, and that measurement of relative acoustic impedance ultrasonically yielded some correlation with aging condition. Some good theoretical discussions on velocity, attenuation and acoustical impedance are presented in this article.

NONDESTRUCTIVE TESTING OF ROCKET COMPONENTS USING
MICROWAVES AND LOW-FREQUENCY ULTRASONICS

R. C. Stinebring and R. H. Harrison

Materials Evaluation
pp 17-22

January 1965

The relationship between microwave dissipation and the physical properties of rocket materials is illustrated. Data are presented on analytical laboratory uses of microwaves and the application of this technique as a tool for quality control of materials.

FORCED FLEXURAL VIBRATIONS OF SANDWICH PLATES IN PLANE STRAIN

Y. Yu

J. Appl. Mechanics
pp 535-540

September 1960

The problem of general forced flexural vibration of sandwich plates in the plane-strain case is solved, using the classical method of separation of variables combined with the Mindlin-Goodman procedure for treating time-dependent boundary conditions.

MEASUREMENT TIME REDUCED ...

Magnaflux Corp.

Magnafacts Vol. 13 No. 3
p 6

Summer 1965

Use of Magnaflux Sonizon for QC in manufacture of jet engine parts.

57. COATINGS

AN ACOUSTIC METHOD OF FAULT-DETECTION IN CERAMIC LINING PLATES

J. Kacprowski & J. Ryll-Nardzewski, J.

Acustica

Vol. 14 pp 76-88

1964

A general description of an acoustic measuring method and an electroacoustic measuring equipment designed for current quality tests of ceramic lining plates is given. The method is based on the physical relations which exist between the acoustical parameters of the plate excited in mechanical vibration and its structural and mechanical properties.

ULTRASONIC METHODS FOR NONDESTRUCTIVE EVALUATION OF CERAMIC COATINGS

W. E. Lawrie

WADD T.R. 61-91, Part 1

Apri. 1961

Armour Research Foundation

The use of ultrasonics to detect flaws and bond strength in ceramic-metal bonds was investigated. Reflectance measurements were rejected in favor of transmission measurements. Two transducer systems using longitudinal and surface wave modes were used and described. Intermodulation techniques were tested, and a charge scanning method of determining the potential at the back of the receiving crystal proved effective for increasing the resolution of the scanning system. It was concluded that the sensitivity of these methods in detecting flaws justify their further development.

U/S METHODS FOR ND EVALUATION OF CERAMIC COATINGS

W. Lawrie & A. M. Baumanis

WADD-TR-61-91, Part II

Feb. 1963

Armour Research Foundation

This report describes investigations into the use of ultrasonic techniques to determine the strength and integrity of ceramic-metal bonds. An acoustic image converter system was used successfully to obtain a television type display of 1/32 in. diameter laminar defects in a zirconium oxide-inconel bond. Schlieren optical and acoustic lens techniques were used to visually investigate detailed properties of ultrasonic fields and the interaction of ultrasonic energy with a solid. The theory of Rayleigh waves is used to explain the results.

U'S METHODS FOR ND EVALUATION OF CERAMIC COATINGS

W Lawrie & A M Baumanis

WADD-TR-61-01 Part III

Armour Research Foundation

Mar 1963

This report describes investigations into techniques to determine the strength and integrity of ceramic metal bonds. Primary emphasis was placed on techniques for examining diffusion coatings although work continued on flame-sprayed coatings. Extensive investigations of Rayleigh wave techniques have been made. Further work was done using the Schlieren optical method, and thermal effects were investigated in relation to the Schlieren results. Investigations of an interferometric method for measurements of elastic constants have shown the method to have low accuracy. Neither destruct nor nondestructive methods have been found to successfully measure bond strength of diffusion coatings. Preliminary investigations have been made of thermal, electrical, and nuclear methods for examining flame-sprayed coatings.

CERAMIC-METAL BOND DEFECT DETECTION USING ULTRASONIC IMAGING

W. E. Lawrie

Paper

Illinois Inst. Of Technology

NEWS OF THE ADHESIVES WORLD - NON-DESTRUCTIVE TESTING

R. L. Myers and C. J. Knauss

Adhesives Age

p 43

Apr. 1965

(Abstracts of papers)

ULTRASONIC MEASUREMENT OF NICKEL PLATE THICKNESS

J. Naughton

FDL Report # CD-3796

NAA/LAD

Feb. 1964

ULTRASONIC DETERMINATION OF NICKEL PLATE ADHESION STRENGTH

J. Naughton and R. Botsco

PDL Lab Memo No. NF-4-4-10
NAA/LAD

Apr. 1964

ULTRASONIC AND CERAMIC COATINGS

R. R. Whymark, W. E. Lawrie

WADD TR 60-157

May 1960

Armour Research Foundation

Optical Schlieren detection system, intermodulation techniques, surface waves, and image converter systems were considered as methods for determining bond strength and detecting defects in ceramic-metal bonds.

SIMPLIFIED VIBRATION ANALYSIS OF ELASTIC SANDWICH PLATES

Y. Yu

J. of Aerospace Sciences
pp 894-900

Dec. 1960

Simplified treatment of the vibration problem for low frequency ranges and for ordinary sandwich plates that have very thin face layers is discussed. Simpler equations of motion of sandwich plates are introduced and their accuracy is determined by comparison with previous more complete equations.

58. THICKNESS

U/S EQUIPMENT FOR HIGH-PRECISION THICKNESS MEASUREMENT

Peter K. Bloch

J. NDT
pp 21-23

May 1953

This paper presents refinements in equipment and technique, to obtain thickness measurements within 1/2 percent of actual dimensions, from one side, with U/S resonance instruments.

PORTABLE ULTRASONIC THICKNESS GAGE

N. B. Branson

Electronics
pp 88-91

Jan. 1948

Description of operation and application of the Audigage.

STANDING WAVE TECHNIQUE OF THICKNESS MEASUREMENTS

J. B. Butler & J. B. Vernon

J. Acoust. Soc. Amer.
Vol. 18 No. 1 pp 212-215

July 1946

Use of the reflectoscope for determining thickness of various types of steels is discussed in detail, including test data resulting from the use of various crystals.

ELASTIC INSTABILITY OF RECTANGULAR SANDWICH PANEL OF ORTHOTROPIC CORE WITH DIFFERENT FACE THICKNESS AND MATERIALS

C. C. Chang and I. K. Ebcioğlu

Trans. ASME
pp. 474-480

Sept. 1960

The instability of rectangular sandwich panels with nonisotropic cores and faces of different materials or thickness. A zone of core shear instability is determined and discussed in detail. Numerical examples are presented to illustrate application of the analysis.

ULTRASONIC THICKNESS MEASUREMENT

Commerce Dept.

Quality Control Digest #1

Apr. 1957

Civil Aeronautics Admin.

THICKNESS MEASUREMENT BY ULTRASONIC RESONANCE

E. G. Cook & H. E. VanValkenburg

J. Acoust. Soc. of America
Vol. 17 No. 3 pp 564-569

May 1955

A mathematical analysis is made of the acoustic system of resonance-type instruments used for thickness measurements from one side only. The approach can be used to evaluate any combinations of test sample, couplant and driving crystal provided their acoustic properties are known.

AN U/S THICKNESS MEASURING INSTRUMENT USING TRANSISTOR LOGIC TECHNIQUES

B. L. Elliot

Electronic Engineering
Vol. 35 pp 738-41

Nov. 1963

A simple experimental transistorized U/S thickness measuring instrument is described. A new approach to the presentation of the thickness information has been adopted, employing binary dividing circuits.

THE SONIGAGE A SUPERSONIC CONTACT INSTRUMENT FOR THICKNESS MEASUREMENT

W. S. Erwin

Research Laboratories Division, General Motors Corp.

U/S THICKNESS MEASUREMENT WITH LAMB WAVES

C. L. Frederick & D. C. Worlton

J. NDT
pp. 51-55

Jan-Feb 1962

Presents a technique for accurate thickness measurements without necessity of close contact between test head and inspected surface. The discussion emphasizes basic theoretical principles underlying the test and presents theoretical data to support them.

INFLUENCE OF TRANSVERSE SHEAR ON NONLINEAR VIBRATIONS OF
SANDWICH BEAMS WITH HONEYCOMB CORES

H. Chu

J. Aerospace Sciences
pp. 405-410

May 1961

Nonlinear equations of motion for a honey-comb sandwich beam are derived. Solution of nonlinear periods is determined for a beam with hinged, immovable ends. Numerical examples are worked out for sandwiches with aluminum alloy facings and aluminum foil honeycomb cores.

ULTRASONICS CUT NOSE-CONE GAGING TIME.

Don Paisley

Aircraft & Missiles
pp 30-32

Feb. 1960

The Vidigage is used to measure thickness of filament-wound plastic nose cones.

U/S RESONANCE THICKNESS MEASUREMENTS BY MEANS OF AN
INTERMEDIATE LIQUID COLUMN

W. Leijssen

Materialprufung Vol. 4 No. 11
pp. 407-10
(German)

Nov. 1962

The article reviews resonance gauging with direct contact between transducer and object and the recently developed non-contact gauging technique.

PROVED ULTRASONIC METHODS FOR STRIP AND PLATE TESTING

H. Kramer Kraut

Materials Evaluation
pp. 404-408

Sept. 1964

A review of various methods in use for continuous testing of strip and plate materials, pointing out strengths and weaknesses of each.

EFFECT OF FREQUENCY VARIATION UPON THE APPARENT RESISTIVITY OF THIS GAGE NON-FERROUS ALLOYS

R. R. Jones & D. B. Hunter

The Martin Company

6. U/S APPLICATIONS, NOT QC

61. SHAPING
ULTRASONICS, AN AID TO METAL FORMING?

B. et. Al. Langenecker

Metal Progress
pp. 97-101

April 1964

A general discussion concerning the application of macrosound in deepdrawing, ironing and wiredrawing processes, and as a potential for industrial applications

U/S METAL FORMING INCHING TOWARD FULL SHOP STATUS

Steel Weekly
pp. 48-50

April 26, 1965

ULTRASONIC ENERGY AIDS TURNING, GRINDING, MACHINING

Steel Weekly
pp. 58-59

July 12, 1965

62. CLEANING
SOUND WAVES SCRUB AND INSPECT

The Iron Age
pp. 75-77

June 24, 1965

63. MISCELLANEOUS

DESIGNING FOR ULTRASONICS

H. Deans

Plastics World
pp. 74-76

Aug. 1965

Design considerations in preparation of plastic products for V/S welding.

THEY "SHOOT" CAR AXLES TO LOCATE INTERNAL DEFECTS

Magnaflux Corp.

Magnafacts, Vol. 13 No. 3
p. 3

Summer 1965

Use of Magnaflux pulse V/S system to inspect railroad car axles.

64. WELDING

U/S INSPECTION OF WELDS

B. Ostrofsky

Welding Research Supplement
Vol. 44 No. 3
pp. 97a-107a

Mar. 1965

ULTRASONIC SEALING

Howard Deans

Plastics Design & Processing
pp. 17-20

August, 1964

Production Welding of Plastic Parts Accomplished by Ultrasonic Sealing.

DEVELOPMENT OF ULTRASONIC WELDING WITH EMPHASIS ON PRODUCING HERMETIC SEALS

J. B. Jones et.al.

Final Summary Report
No. RR-61-69

Sept. 1963

Aeroprojects, Inc.

Uniformly reproducible V/S ring and continuous seam welds of hermetic-seal quality were produced in several alloys of different gages and in various geometries.

SONOBOND ULTRASONIC WELDING UNIT

Welding Research
p. 938

Nov. 1963

Descriptive brief on Sonobond Model W-260-TSL

7. STANDARDS

71. NDT, GENERAL

REPORT OF COMMITTEE E-7 ON NON-DESTRUCTIVE TESTING

ASTM (Reprint) Meeting held June 1964

1964

REPORT OF COMMITTEE E-7 ON NDT.

ASTM

ASTM Meeting of June 1965
(Reprint)

1965

COMMONLY USED SPECIFICATIONS & STANDARDS FOR NDT.

J. NDT.
pp. 138-140

March-April 1961

A STUDY ON GREATER UTILIZATION OF INDUSTRY IN THE PREPARATION
OF SPECIFICATIONS AND STANDARDS

Publications

Dir. of Technical Publications and Specifications Systems
Engineering GroupResearch and Technology Division
WPAFB

Feb. 1964

72. U/S TESTING

U/S STANDARDS FOR THE EVALUATION OF MISSILES MATERIALS AND COMPONENTS

C. J. Adams and J. W. Morris

(paper) 3rd Pac.Area Nat. Mtg. of Am. Soc. for Testing
Matls. (San Francisco) Oct. 12, 1959

ULTRASONIC TECHNIQUES AND STANDARDS FOR TESTING FILAMENT-WOUND STRUCTURES

C. M. Adams - H. H. Radtke - J. D. Klein

ML TDR 64-117

May 1964

Douglas Aircraft MSSD

Immersed through transmission, immersed and contact pulse echo methods were used to determine optimum testing techniques for filament-wound reinforce resin-glass structures. Test specimens were fabricated with simulated defects. It was found that the best method was the through-transmission in conjunction with facimile recordings method.

RECOMMENDED PRACTICE FOR ULTRASONIC TESTING BY THE REFLECTION METHOD, USING PULSED LONGITUDINAL WAVES INDUCED BY DIRECT CONTACT.

ASTM

Adopted 1963

TENTATIVE METHOD FOR ULTRASONIC CONTACT INSPECTION OF WELDMENTS

ASTM

ASTM Designation: E 164 - 62 T

Issued 1960
Revised 1962

TENTATIVE RECOMMENDED PRACTICE FOR FABRICATING AND CHECKING ALUMINUM ALLOY ULTRASONIC STANDARD REFERENCE BLOCKS

ASTM

Issued 1958
Revised 1961

TENTATIVE RECOMMENDED PRACTICE FOR ULTRASONIC TESTING BY THE RESONANCE METHOD

ASTM

Issued 1955

70-S EFFECTS OF TEST SPEED ON ULTRASONIC FLAW DETECTION
RELIABILITY

John P. Bacon

J. NDT Vol. 20, No 6
p. 380-382

Nov., Dec. 1962

Test procedures and results of ultrasonic inspection immersion tests using a quartz and a lithium sulfate transducer to determine effects of the transducer movement speed on flaw detection reliability. Analysis of transducer sensing width versus receiver dynamic range, transducer size and flaw size.

STANDARIZATION AND APPLICATION OF ULTRASONIC SURFACE WAVE
INSPECTION

G. J. Binczewski

J. NDT
pp. 36-40

Jan., Feb. 1957

Ultrasonic surface waves are discussed as a reliable and economic method of detecting surface discontinuities. Factors which influence test results were considered. It was concluded that the method is effective for cases in which the detection aspect is of prime importance, but is not applicable to detection and evaluation without a critical analysis of factors which affect surface propagation.

A PRIMARY ULTRASONIC STANDARD

S. Boghosian and J. W. Orner

WAL TR 143.8/1

Dec. 1961

Watertown Arsenal Laboratories

A method is suggested by which the respose obtained from a steel ball in water can be utilized for accurately defining any desired level of instrument sensitivity. Acceptance levels can be specified in terms of parameters which ca be strictly defined for specification purposes.

STANDARDIZATION IN U/S TESTING

C. W. Cline and J. B. Morgan

J. Soc NDT Vol. 13 No. 4
p. 23-27

July - Aug. 1955

Progress toward standardization of operation of U/S equipment is discussed, including use of reference blocks, electronic checking equipment and monitors.

RESEARCH & DEVELOPMENT LEADING TO THE ESTABLISHMENT OF U/S TEST STANDARDS FOR AIRCRAFT MATERIALS

G. L. Cross, et.al.

WADC - TR 59-466
AF Materials Laboratory

Feb. 1960

The report contains results of a four phase study of materials and techniques concerning the evaluation of internal flaws by ultrasonic means. The four questions studied were; what material variables affect the transmission of ultrasonic compressional waves in certain aircraft materials? What material and geometrical variables affect transmission of shear and surface waves in this sheet materials? What are the quantities involved when altering the beam diameter by collimation? and, what correlation exists between the ultrasonic and mechanical properties of materials which contain quantities of minute porosity.

REVIEW OF CURRENTLY AVAILABLE SPECIFICATIONS & PROCEDURES FOR THE U/S INSPECTION OF STEEL *

Edward T. Graboski

J. NDT
pp. 245-247

July - Aug. 1962

* Paper presented before the 20th National Conv. of the Society, 17 Oct. 1960, Philadelphia, Pa.

DETERMINING THE DIMENSIONS OF FLAWS ULTRASONICALLY WITHOUT
STANDARD SPECIMENS

V. S. Grebennik, et.al

Zavodskaya Laboratoriya
Vol. 29 No. 10
pp. 1181-1186

Oct. 1963

(Translation)

The method is based on a measurement of the ratio between the signal amplitudes from a flaw for various positions of a piezoelectric transducer to the distance from the surface of an object as the transducer is shifted from the position corresponding to the greatest amplitude of reflected signal.

PHYSICAL FACTORS AFFECTING RELIABILITY OF U/S NDT

L. Kay et.al

Brit. Instn. Radio Engrs. (J.)
Vol. 23 No. 5
pp. 373-80

May 1962

U.D.C. 534.23:620.179
West Midland Section' Symposium

Dec. 1961

STANDARDIZATION IN ULTRASONIC TESTING

J. D. Lavender and R. M. Pilgrim

Journal B.S.C.R.A. No. 75

Oct. 1963

Standards adopted by the aluminum industry in Britian and the USA are reviewed and a standard cast steel test block, which the steel industry may find useful, is described.

U/S TESTING PROCEDURES

J. B. Morgan

J. NDT pp. 32-36

Jan. - Feb. 1959

Results obtained from U/S inspection of approx. 150 reference blocks prepared from stainless steels, tool steels and high temperature alloys are presented.

DEVELOPMENT OF ASTM STANDARD REFERENCE BLOCKS FOR U/S INSPECTION

F. C. Panian and H. E. Van Valkenburg

J. NDT
pp. 45-57

Jan. - Feb. 1961

NEW MOLY REFERENCE BLOCKS IMPROVE SONIC TESTING

R. C. Rhoades

Iron Age Vol. 186 No. 17
pp. 94-95

Oct. 1960

IMMERSED ULTRASONIC INSPECTION BY C-SCAN FACSIMILE RECORDING

Rocketdyne

Process Specification: No. RA0115-125
NAA/R

May 1964

RECOMMENDED U/S ACCEPTANCE STANDARDS FOR AIRFRAME ALUMINUM ALLOY
PLATE, FORGINGS, & EXTRUSIONS

SNT Airframe Committee Report No. 1 (revised)

J. NDT
pp. 57-60

Jan. - Feb. 1962

ULTRASONIC STANDARDS

U/S (unidentified)

Manuscript released 15 Nov. 1961
as ASD - TDRULTRASONIC TESTING CALIBRATION AND STANDARDS PROGRAMS IN THE
UNITED STATES

H. E. Van Valkenburg

Sperry Products Reprint 50-806

1960

Reprint from a paper presented before the 3rd International Cong.
on NDT held in Tokyo, Japan 18 Mar. 1960
Includes a bibliography on Specifications.

73. RADIOGRAPHY

MILITARY STANDARD INSPECTION, RADIOGRAPHIC

MIL-STD-453

4 September 1963

74. MISCELLANEOUS

"MILITARY STANDARD JOINT ELECTRONICS TYPE DESIGNATION SYSTEM"

MIL-STD-196A

"MILITARY STANDARD TYPES AND DEFINITIONS OF MODELS FOR
COMMUNICATIONS-ELECTRONICS EQUIPMENT"

MIL-STD-243A

31 August 1964

BONDING STRENGTH (STANDARDS)

FED TEST METHOD STD NO. 406

5 October 1961

INTRODUCTION TO STATISTICAL ANALYSIS

W. J. Dixon and F. J. Massey, Jr.

McGraw-Hill Book Co. N. Y.

1951

8. HONEYCOMB MATERIALS

81. PROPERTIES

NEW GRIP ON HONEYCOMB

Aircraft & Missiles

November 1959

Use of Zincilate, water soluble surface protective agent,
to hold honeycomb during machining operations.

MECHANICAL PROPERTIES AND TESTS

J. B. Campbell

Materials & Methods
(reprint) Manual No. 106

July 1954

Glossary of the common engineering materials

NATURAL FREQUENCIES OF HONEYCOMB STRUCTURES

R. H. Grissom

Product Engineering Vol. 31, p. 83

February 1960

BOND STRESSES IN A RANDOMLY VIBRATING SANDWICH PLATE:
SINGLE MODE THEORY

D. J. Mead

J. Sound & Vibration Vol. 1 No. 3
pp 258-269

1964

The method of generalized harmonic analysis is applied to the estimation of bond stresses normal to the surface of a honeycomb sandwich plate which is subjected to a randomly varying load such as jet noise pressures. Motion of the plate is restricted to a single principal mode of flexural vibration.

"ON METHODS AND DATA REQUIRED FOR HEAT SHIELD CALCULATIONS"

G. Mounis

NASA TT F-294

February 1965

NASA Technical Translation from Sub-Aviation,
Doc. No. 68.515/64

DEVELOPMENT OF FORMING AND JOINING TECHNIQUES FOR
CORRUGATED SANDWICH STRUCTURE

H. Smallen and R. P. Romaine

Welding Journal
Vol 39 pp 314-21

April 1960

The development of forming and joining techniques for fabrication of an engine exhaust duct from corrugated sandwich structure is described. Included are rolling, manual and automatic fusion welding, resistance spot and tungsten-arc spot welding.

SANDWICH DESIGN ...B-70 SPURS WIDER USE OF
PART I.

Space/Aero Vol 35
pp 96-99

March 1961

SANDWICH DESIGN ...NEW METHODS SET PACE OF PROGRESS FOR
PART II

Space/Aero Vol 35
pp 50-55

March 1961

SELF SEALING STRUCTURES ... SANDWICH DESIGN
PART III

Space/Aero Vol 35
pp 56-57

March 1961

FASTENING HONEYCOMB COMPONENTS

P. J. B. Stevens, and L. M. Polentz

Materials in Design Engineering
pp 123-126

April 1960

"BRASING RENE 41 HONEYCOMB SANDWICH STRUCTURES"

A. O. Vanaman and J. W. Greagor

Welding Research Supplement
pp 353S - 358S

August 1963

Techniques are developed for brazing sandwich panels using Mn-Ni-Co-B braze alloy and an argon atmosphere.

82. MECHANICAL TESTING

"STRESS RESPONSE AND FATIGUE LIFE OF ACOUSTICALLY EXCITED SANDWICH PANELS"

NA-64-413

NAA/LAD

Acoustically excited brazed steel honeycomb panels are analyzed. Stress and life for both the honeycomb core and facesheets are computed for variations in the basic panel parameters.

THE SHEAR MODULUS OF HONEYCOMB CORES

Hiroshi Nagao

9th Japan National Congress for Applied Mechanics,
Proceedings, 1959 p. 97-100

1959

The apparent shear modulus of hexagonal honeycomb cores... used in aircraft construction is investigated by theoretical analysis.

83. NDT

ACOUSTICAL TESTING OF HONEYCOMB STRUCTURES FROM ONE ACCESSIBLE SIDE (RESONANCE TECHNIQUE)

R. J. Botsco

NAA/LAD Report No. CD-3804

June 1964

"MEANS AND METHOD FOR TESTING OF COMPOSITE SANDWICH STRUCTURES"

R. A. Davis, et. al.

U. S. Patent Office #3,008,029

November 7, 1961

"METHOD AND APPARATUS FOR INSPECTING HONEYCOMB PANELS"

A. L. Klein and G. G. Grimm

U. S. Patent Office No. 2,782,632

February 26, 1957

"SONIC TESTER CHECKS BONDING OF HONEYCOMB PANELS"

H. O. Williams

American Machinist
pp 116-117

September 1, 1952

84. ADHESIVES PROPERTIES

ADHESIVES-STILL LOTS OF POTENTIAL FOR AEROSPACE STRUCTURES

Aircraft and Missiles
pp 34-37

February 1960

A general review of adhesive types and characteristics, including design tips.

ADHESIVE BONDS FOR SANDWICH CONSTRUCTIONS

George Epstein

Adhesives Technology
Vol 6 No. 8 pp 30-33

August 1963

An analysis of the factors to be taken into consideration when designing adhesively bonded structures was presented. Creep, impact, fatigue, core-to-skin facing bonds, strength were discussed as factors to be noted. Strengthening devices were mentioned and splicing of cores considered.

ELASTOMERIC STRUCTURAL ADHESIVES

Martin M. Grover and John Romanick

Adhesives Age
pp 30-33

November 1963

The application, use, and characteristics of elastomeric adhesives are briefly discussed. It is mentioned that these adhesives have to be carefully cured in order to obtain ultimate strength and performance.

PRESSURE-SENSITIVE ADHESIVES: WHAT MAKES THEM STICK?

Charles W. Hock

Adhesives Age
pp 21-25

March 1964

The morphology of various resin and rubber films was investigated with the aid of the electron microscope. The effect of resin concentration was discussed. Neoprene adhesives were considered.

PROPERTIES & TESTING OF HIGH STRENGTH ADHESIVES

G. A. Iikka

Metals Engrg. Quarterly
Vol 2 No. 2 pp 30-34

May 1962

Compositions of several types of high-strength adhesives and various tests for strength properties are described, and comparisons of strength properties for various types of adhesives are made.

EFFECT OF LOADING RATE ON ADHESIVE STRENGTH

Frank Moser and S. S. Knoell

ASTM Bulletin No. 227
pp 60-63

January 1958

Significant differences between loading rates, testing machines and adhesives are presented.

STRUCTURAL ADHESIVES FOR CRYOGENIC APPLICATIONS

B. Pascuzzi and J. R. Hill

Adhesives Age
pp 19-26

March 1965

Four adhesives were evaluated with the objective of developing a simple adhesive bonding process for 2219 aluminum. Tensile-shear and vibration fatigue were used for preliminary screening tests, followed by a variety of subsequent tests at various temperatures.

ADHESIVE BONDING OF TITANIUM

H. E. Pattee, et al

Materials in Design Engineering
vol 49 pp 96-99

February 1959

Review of available adhesives, surface treatments and design factors.

ADHESIVES

L.H. Sharpe, et al

Int. Science & Technology pp 26-37

Apr 1964

Molecular theory of adhesion is explored. Examples of adhesive application and characteristics supporting the theory are presented; industrial use of adhesives and future needs are reviewed.

BENEFITS OF ADHESIVES HINGE ON SHIFT TO NEW APPROACHES

Steel
pp 40-43

January 18, 1965

A comprehensive review of various types of adhesives and

85. ADHESIVES, MECHANICAL TESTING

TENSION TEST OF FLAT SANDWICH CONSTRUCTIONS IN FLATWISE PLANE

ASTM

ASTM Des: C297-61

Adopted 1956
Revised 1961

TENSION TEST OF FLAT SANDWICH CONSTRUCTION IN FLATWISE PLANE

ASTM C 297-61
pp 12-15Adopted 1955
Rev. 1961STRENGTH PROPERTIES OF ADHESIVES IN SHEAR BY TENSION
LOADING (METAL TO METAL)

ASTM

ASTM Des: D1002-64

Adopted 1964
Revised 1964STRENGTH PROPERTIES OF ADHESIVES IN SHEAR BY TENSION
LOADING (METAL TO METAL)ASTM D 1002-64
pp 290-295Adopted 1964
Revised 1964

PEELING FORCE OF ADHESIVE JOINTS

F. S. C. Chang

Trnas. of Soc. of Rheology IV
pp 75-89

1960

A PURE SHEAR TEST FOR ADHESIVES

L. B. Clougherty and D. M. Teague

SAE paper 471F
Automotive Engineering Congress

January 8-12, 1962

"DEVELOPMENT AND EVALUATION OF THE CLEMBING PEEL METHOD
FOR TESTING ADHESIVE BONDS IN SANDWICH AND METAL TO
METAL CONSTRUCTIONS"

H. W. Eickner and F. Werren

WADC T.R. 56-386
Materials Laboratory W-P AFB

September 1956

PEEL ADHESION - PART I PHENOMENOLOGICAL ASPECTS OF THE TEST

J. L. Gardon

J. Appl Polymer Sci
Vol 7 pp 625-641

1963

Peeling force variation with the peeling rate and adhesive layer thickness is shown. The nature of the variability of the steady-state force when all testing variables are held constant is discussed.

PEEL ADHESION - PART II A THEORETICAL ANALYSIS

J. L. Gardon

J. App Polymer Sci
Vol 7 pp 643-665

1963

The rate-independent adhesive failure data are discussed in terms of a newly developed theory. In this theory, the dependence of the peeling force upon the thickness of adhesive layer is terms of such parameters as the moduli of the substrate and the binder, the thickness of the substrate, etc.

THE MECHANICAL TESTING OF HIGH POLYMERS

H. Kolsky

Progress in NDT, Vol. II
Gordon & Breach
Science Publishers, Inc. N. Y.

1964

METAL ADHESION TECHNIQUES

A. Matting

Elektrotec, U. Maschinenbau
Vol 75 pp 83-84 (German)

1958

Effect of U/S waves on strengthening adhesive forces.

MECHANICAL TESTING OF ADHESIVES IN A CREEP FURNACE AT
TEMPERATURES RANGING FROM 200 to 2400F

A. E. Slobodzinski

Tech Memo. 1061
Feltman Research Laboratories,
Picatinny Arsenal,
Dover, N. J.

September 1962

PERFORMANCE OF METAL-ADHESIVE JOINTS

K. Wellinger and U. Rembold

VDI Zeitschrift 100
pp 41-46 (German)

January 1958

9. REINFORCED COMPOSITES

91. MISCELLANEOUS

DEVELOPMENT OF HIGH STRENGTH, LOW DENSITY COMPOSITE MATERIALS
FOR SATURN APPLICATIONS

J. W. Huffman

NAA/LAD Report No. NA-63-1358-3

January 1964

Quarterly Progress Report 10-1-63 to 1-1-64

DEVELOPMENT OF HIGH STRENGTH, LOW DENSITY COMPOSITE
MATERIALS FOR SATURN APPLICATIONS

J. W. Huffman

NAA/LAD NA-63-1358-13

January 1965

Annual summary report 1 October 1963 to 31 December 1964,
Contract NA-58-11108

FIBER-REINFORCED METALS

A. Kelly

Scientific American

February 1965

THE PROMISE OF COMPOSITES

Materials & Design Engineering (magazine)
Spec. Report No. 210

September 1963

General structural characteristics of composites are outlined
and it is shown how this morphology can be the basis of a
simple scheme for descriptive classification and for predicting
behavior.

METAL MATRIX COMPOSITES

NAA/LAD

NA-64-1124

STATE OF THE ART, FLAKE-GLASS LAMINATES

Allen M. Shibley

OTS PB 161947

October 1960

Picatinny Arsenal, Plastic Report #1

Achievements in the production of glass flake and glass flake laminates are presented, including manufacture and testing of glass flake, coating with resin binders, and properties and fabrication of glass flake laminates.

92. PROPERTIES

DEFECTS OF IMPORTANCE IN THE SPECIFICATION OF REINFORCED PLASTICS PRODUCTS

R. F. Barnet

NAVORD Report 2797

March 1953

U. S. Naval Ordnance Laboratory
White Oak, Maryland

A discussion of the visual characteristics and various flaws to be found in glass reinforced plastics is presented.

THE FATIGUE RESISTANCE OF REINFORCED PLASTICS

J. W. Davis, et al

Materials in Design Engineering
pp 87-91

December 1964

Data on fatigue properties of reinforced plastics are presented and it is shown how behavior can be controlled by proper choice of fibers, resins and laminate orientation.

93. MECHANICAL TESTING

EVALUATION OF GLASS FABRIC REINFORCED PLASTIC LAMINATES

F. R. Barnet

NAVORD Report 2669
U. S. Naval Ordnance Laboratory
White Oak, Maryland

January 1953

EVALUATION OF HIGH STRENGTH AND MODULUS BRITTLE
MATERIALS IN FILAMENT AND COMPOSITE FORMS

W. J. Clark, et al

Stds. for Filament Wound Reinforced Plastics
pp 146-163A TELEVISION X-RAY IMAGE ENLARGEMENT SYSTEM FOR
NONDESTRUCTIVE TESTING OF FIBER GLASS REINFORCED
PLASTIC MISSILE CASE MATERIALS

M. L. Rhoten and R. C. McMaster

Standards for Filament-Wound Reinforced Plastics
pp 287-299
ASTM STP-327

June 1962

DEVELOPMENT OF NDT METHODS FOR THE EVALUATION OF THIN AND
ULTRATHIN SHEET MATERIALS

G. Schmitz, et al

ML TDR 64-278

September 1964

General American Transport Corp.
for AF Materials Laboratory

This report describes activity on the subject program for the first year including a survey of literature, equipment, research efforts, and nondestructive testing needs. As a result of this survey, the second portion of the first year's activity was directed toward the development of thin sheet nondestructive test instrumentation in the field of high frequency eddy current equipment, Lamb wave ultrasonic techniques, and electrostatic testing techniques.

TENSILE STRENGTH OF ADHESIVE BONDS IN SANDWICH WITH
ALUMINUM FACINGS AND ALUMINUM HONEYCOMB CORES

V. C. Setterholm, et al

WADD TR 56-239

June 1956

Forest Products Laboratory

PATENTS

BROAD BAND ELECTROACOUSTIC TRANSDUCER

F. R. Abbott

U.S. Patent No. 2,895,062

14 July 1959

ELECTRO-ACOUSTIC TRANSDUCER FOR OMNIDIRECTIONAL SEARCH

H. O. Benecke

U.S. Patent No. 2,961,636

November 22, 1960

ACOUSTIC IMPEDANCE ELEMENT

T. F. Burke

U.S. Patent No. 2,754,925

July 17, 1956

ACOUSTIC IMPEDANCE MEASURING APPARATUS

S. A. Caldwell

U.S. Patent No. 2,837,914

June 19, 1958

PIEZOELECTRIC CRYSTAL MOUNTING MEANS

B. Carlin

U.S. Patent No. 2,448,352

August 31, 1948

PIEZOELECTRIC CRYSTAL MOUNTING MEANS

B. Carlin

U.S. Patent No. 2,448,352

August 31, 1948

ULTRASONIC TRANSDUCER

F. J. Fry

U.S. Patent No. 2,863,575

December 2, 1958

COAXIAL CRYSTAL MOUNT

E. Hafner

U.S. Patent No. 2,891,177

June 16, 1959

IMPEDANCE MATCHING MEANS FOR MECHANICAL WAVES

C. W. Hansell

U.S. Patent No. 2,430,013

November 4, 1947

ULTRASONIC SCANNING HEAD

G. A. Klatchko

U.S. Patent No. 3,121,326

February 18, 1964

VARIABLE ANGLE ULTRASONIC TRANSDUCER

W. E. Mesh

U.S. Patent No. 2,602,101

July 1, 1952

TRANSDUCER

H. Pollack

U.S. Patent No. 2,956,184

October 11, 1960

GENERATION AND TRANSMISSION OF SOUND PULSES

G. C. Seavey

U.S. Patent No. 2,620,766

December 9, 1952

ULTRASONIC BEAM SHAPING DEVICE

J. C. Snack

U.S. Patent No. 2,657,319

October 27, 1953

SUPPORT FOR VIBRATORY DEVICES

W. C. Elmore

U.S. Patent No. 2,891,180

June 16, 1959

ULTRASONIC BEAM SHAPING DEVICE

J. C. Snack

U.S. Patent No. 2,657,319

October 27, 1953

VARIABLE ANGLE ULTRASONIC SEARCH UNIT

H. E. Van Valkenburg

U.S. Patent No. 2,709,760

May 31, 1955

FOCUSING ULTRASONIC RADIATOR

G. W. Willard

U.S. Patent No. 2,645,727

July 14, 1955

ELECTROACOUSTIC DEVICE

A. L. W. Williams

U.S. Patent No. 2,632,634

March 24, 1953

FOCUSING ULTRASONIC RADIATOR

G. W. Willard

U.S. Patent No. 2,645,727

July 14, 1953

TRANSDUCER H. Pollack U.S. Patent No. 2,956,184	October 11, 1960
ULTRASONIC INSPECTION APPARATUS J. V. Cowan U.S. Patent No. 3,121,324	22 February 18, 1964
SUPERSONIC TESTING APPARATUS T. M. Berry et al U.S. Patent No. 2,527,208	23 October 24, 1950
ULTRASONIC FLAW DETECTOR D. C. Erdman U.S. Patent No. 2,593,865	April 22, 1952
SUPERSONIC INSPECTION DEVICE F. A. Firestone U.S. Patent No. 2,398,701	April 16, 1946
FLAW DETECTING DEVICE AND MEASURING INSTRUMENT F. A. Firestone U.S. Patent No. 2,280,226	April 21, 1942

APPARATUS FOR DETERMINING RESONANT FREQUENCIES

A. Stewart

U.S. Patent No. 2,576,423

November 27, 1951

24

SUPERSONIC TESTING

B. Carlin

U.S. Patent No. 2,527,986

October 31, 1950

ULTRASONIC MEASUREMENT APPARATUS

D. C. Erdman

U.S. Patent No. 3,009,353

November 21, 1961

APPARATUS FOR LOCATING DEFECTS

W. Grabendorfer

U.S. Patent No. 2,846,875

August 12, 1958

METHOD AND APPARATUS FOR ULTRASONIC SHEARWAVE INSPECTION

E. A. Henry

U.S. Patent No. 3,115,771

December 31, 1963

METHOD AND APPARATUS FOR DETECTING HIDDEN FLAWS
IN SHEET LIKE STRUCTURES

D. G. Miller

U.S. Patent No. 3,038,329

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